WIRE AND WIRE PRODUCTS

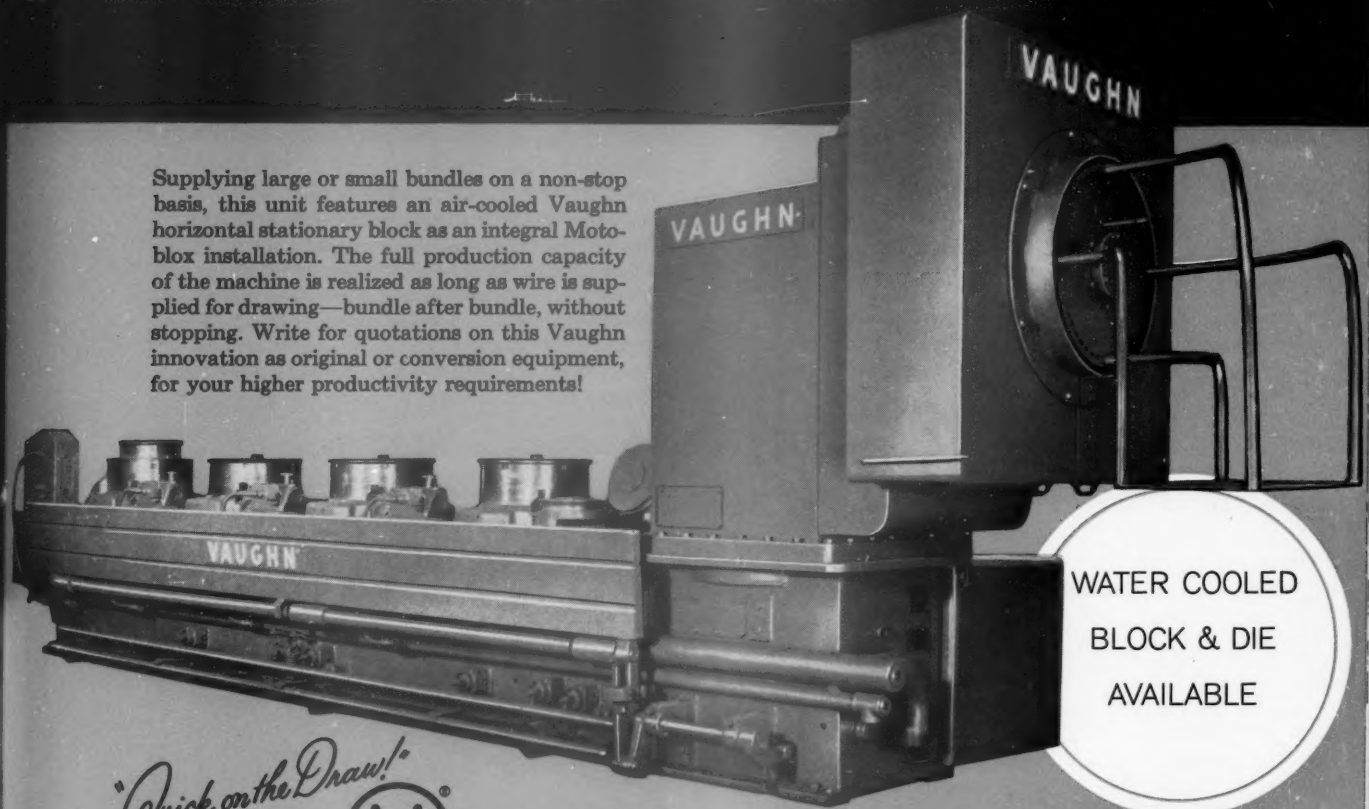
NOVEMBER 1960

For Continuous High Production!

The Vaughn® Motoblox®

with INTEGRAL HORIZONTAL STATIONARY BLOCK

Supplying large or small bundles on a non-stop basis, this unit features an air-cooled Vaughn horizontal stationary block as an integral Motoblox installation. The full production capacity of the machine is realized as long as wire is supplied for drawing—bundle after bundle, without stopping. Write for quotations on this Vaughn innovation as original or conversion equipment, for your higher productivity requirements!



WATER COOLED BLOCK & DIE AVAILABLE

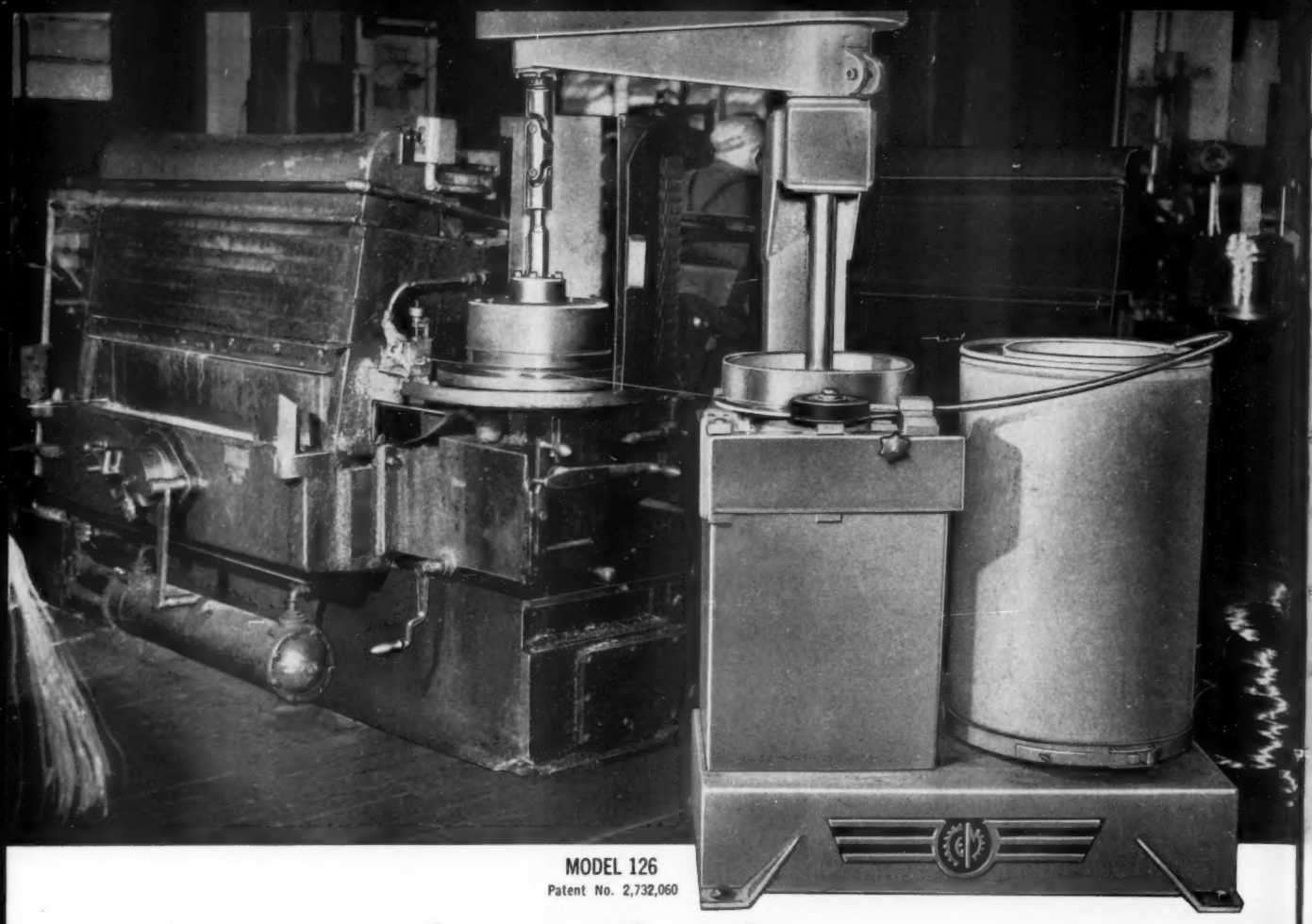
"Quick on the Draw!"

The Vaughn Machinery Company

Cuyahoga Falls, Ohio, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION



MODEL 126
Patent No. 2,732,060

Just one of **several** styles of continuous wire packaging attachments!

It's easy for you to *adapt your existing machinery* to continuously package wire in fibre containers! And it can be done on a short term delivery basis without a large expenditure in new equipment. With Coulter & McKenzie Attachments your old machines will *continuously* pour wire into drums . . . 500 pounds in each . . . all ready for delivery!

These features make installation simple and economical:

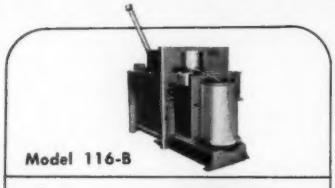
SYNCHRONOUS OPERATION through positive Overarm Drive from any vertical or horizontal block.

COMPACT DESIGN allowing the Attachment to be located in any one of many positions around your machinery.

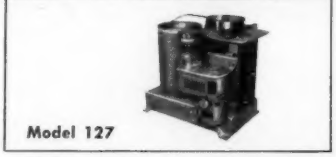
CONVENIENT OVERARM disconnects and swings aside for selective return to conventional coil and spool operation.

The Coulter & McKenzie Attachments will be built to your specifications. The model illustrated above is for fine wire use.

Write today for the Coulter & McKenzie "Attachment Questionnaire."



Model 116-B



Model 127

Other machines are available for continuously drawing (Series 116 and 138 Draw-Pak) or packaging (Series 127) fine or coarse wire. Write today for complete information . . . kindly state your requirements.

A FULL RANGE OF WIRE FROM SOFT COPPER TO HIGH CARBON, AND FROM .012" TO .250" IS BEING PAYOFFPAKAGED.

This equipment manufactured under one of the following U. S. Patents 2,732,060; 2,868,474; 2,844,416; 2,868,268 or others pending.

Barron & Crowther Ltd., Eastleigh, Hants, England, European Draw-Pak Licensee
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TELEPHONE EDISON 5-1101
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THE COULTER & McKENZIE MACHINE CO., INC.

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USE LUBRICANTS WITH BUILT-IN MUSCLE!

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LET THESE ECONOMICALLY PRICED PREMIUM LUBRICANTS WORK FOR YOU!

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Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

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1. Uniform size pellet — for even color dispersion.
2. No color contamination in factory as pellets provide a dust free concentrate.
3. Blane color concentrates give rapid and full dispersion under heat.
4. Concentrations per pound yield maximum color power.
5. Blane concentrates have proven to be excellent for heat stability and light fastness.
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7. Greater economy — personal service.

We have in inventory all NEMA colors; special color concentrates are available on custom basis. Our laboratory people will be pleased to assist you on any color problem. Write for information and samples.

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CANTON, MASSACHUSETTS

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If you use pre-shaped wire—wire with special or unusual cross-sections—PAGE can supply the wire you need, in a wide variety of steels, packaged the way that's best suited to your operations.

PAGE can furnish *any* shape, ranging from the simplest standard shapes to complex "specials." You can specify low carbon, high carbon, alloy or stainless steels, or Armco ingot iron. Strict specifications covering physical properties and size tolerances are no problem at PAGE, the leading special-purpose wire producer. PAGE also offers packaging tailored to your specific requirements.

Most important, you can count on PAGE accuracy and uniformity—regardless of your use of shaped wire.

SEND US A SAMPLE of the shaped wire you use now, with information as to analysis and your tonnage requirements. We'll be glad to recommend a **PAGE** shaped wire to help you reduce your costs or improve your products. For details on PAGE shaped wire, write us at Monessen, Pa., for **Booklet DH-1226**—or for information on the many other manufacturers wire items available from PAGE.

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PAGE *—the source for answers to wire problems*

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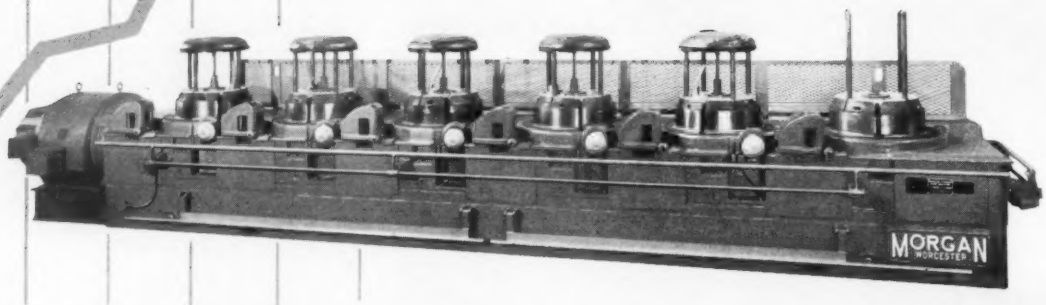

with IMPROVED MORGAN-CONNOR Wire Machines

Morgan-Connor offers you a wide range of wire drawing machines of proven efficiency—with up-to-the-minute refinements. You can produce heavy-weight bundles—fast—and with low power and low die cost.

MORGAN CONSTRUCTION CO.
WM-114
WORCESTER, MASSACHUSETTS, U. S. A.

ROLLING MILLS | MORGOIL BEARINGS • WIRE DRAWING MACHINES • COMBUSTION CONTROLS

WIRE AND WIRE PRODUCTS*

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 35 November, 1960 No. 11

Designated as Official Publication By The Wire Association

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Tools that produce more for them — produce more for you.

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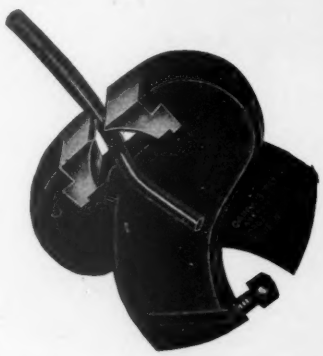

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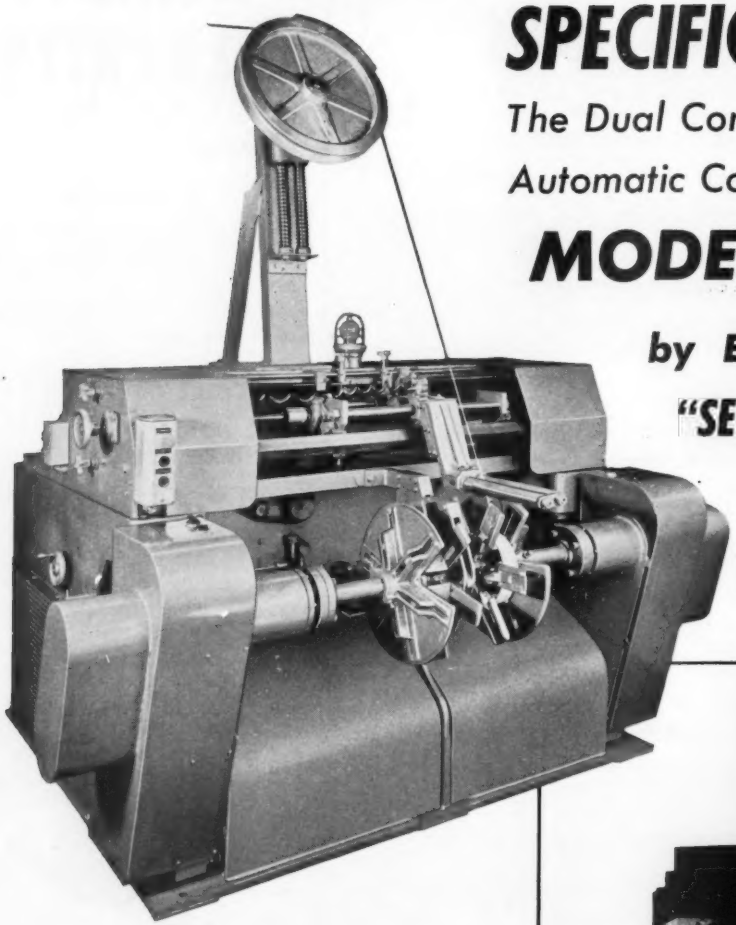
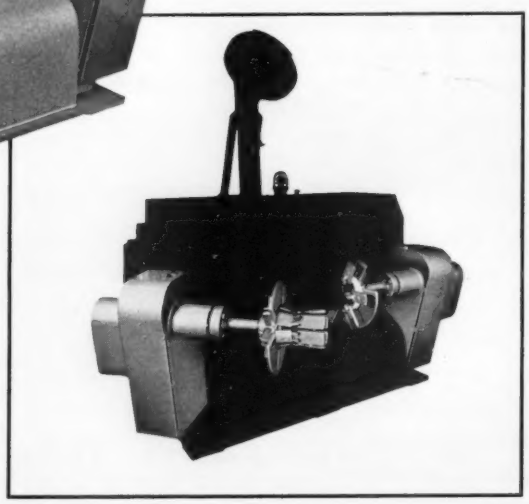
Automatic Coiler

MODEL TC-24

by ENTWISTLE

"SENSIBLE LINK TO AUTOMATION"





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Are the savings you can realize from reduced handling and space requirements, through elimination of the secondary coiling operation.

SENSIBLE —

Because the modernization to Continuous Coiling is accomplished without further changes to the existing extrusion equipment.

Produce and package in one operation.

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Over 40 years of dependable service
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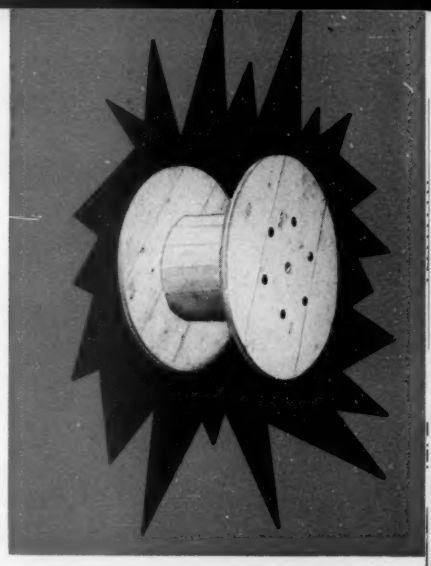
Blackburn, Lancs., England

Saw mill at Bradford, N. H., where logs are processed into lumber.

HOW BRIDGE SUPPLIES ONLY THE BEST REELS



Our company is progressive. Since we began the manufacture of wood reels our plant has undergone continued expansion and improvement in production facilities.

In recent years modern affiliated companies have been established in New Hampshire to further enable us to better serve the growing needs of the wire industry.

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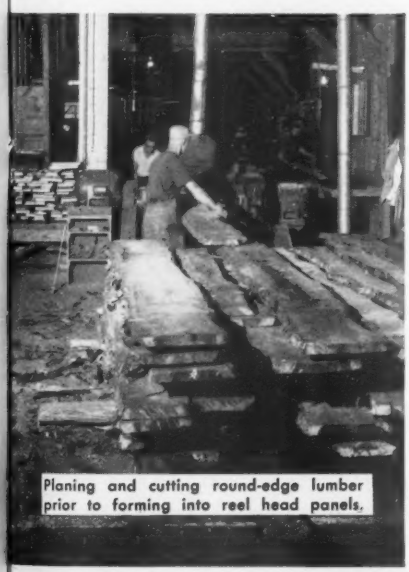
WOOD REELS IN ALL SIZES FOR ALL TYPES OF ELECTRIC WIRE AND CABLE

- Controlled saw mill work
- Air seasoning of lumber
- Conversion of stock into panels and square-edge lumber
- Maintenance of millions of board feet of lumber in inventory
- Efficient, modern material handling methods and equipment

Interior of the Kearsarge plant.

Plant of Kearsarge Reel Co. — an affiliate of Bridge Manufacturing Co.



Planing and cutting round-edge lumber prior to forming into reel head panels.

NON-RETURNABLE REELS GIVE YOU A DEFINITE PACKAGING COST

Interior of Hill mill showing manufacture of panels for reel heads.

Hill Box Company's panel mill — another BRIDGE affiliate.

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Let us quote on your Reel needs. Send in your specifications. Better yet, visit our plant and see how Reels are made so well at so low a cost.

WOOD REELS

HIGH-SPEED SHIPPING SERVICE IN OUR OWN TRUCKS WITHIN A RADIUS OF 250 MILES OF THE PLANT, FAST FREIGHT WILL BRING YOU BRIDGE REELS WITHIN A FEW DAYS TO POINTS EAST OF THE MISSISSIPPI

TEL: THOMPSONVILLE, CONN.

D. C. Forry, sales manager for Ridge Door, left, shows Pittsburgh Steel Salesman Robert Hogan how each spring is tagged, indicating pounds pull to assure that the proper weight garage door is matched with the proper springs.

Testing a 25-inch long extension spring to determine the pounds pull required to extend the spring to 67 inches. Engineering formulas tell workers what weight springs will balance each door. Correct pounds pull is marked on tag which is fastened to spring

How Pittsburgh Steel's Wire Helps A Door Man Keep His Balance

Ridge Door Company Uses Oil Tempered Spring Wire From Pittsburgh Steel Company To Coil Extension And Torsion Springs Which Balance Garage And Industrial Doors Within Five Pounds

It takes an even temper to make a garage door.

For Ridge Door Company of Monmouth Junction, N.J., "even temper" means dependable uniformity in oil-tempered spring wire it gets from Pittsburgh Steel Company.

Garage doors are deceiving. Doors identical in style and size can vary as much as 30 pounds in weight due to the wood's moisture content and other factors. Yet the springs which open and lower doors with mere finger-tip pressure must be in near perfect balance.

Uniformity of Pittsburgh Steel's oil-tempered spring wire enables Ridge Door, a division of Muskegon Motor Specialties Company, to match individual doors to springs whose pull is within five pounds of the door's weight. Here's that story:

The matching process begins with completion of the wooden door, made of high altitude, kiln-dried hemlock or Douglas fir. Each finished door is weighed carefully and tagged to show its weight.

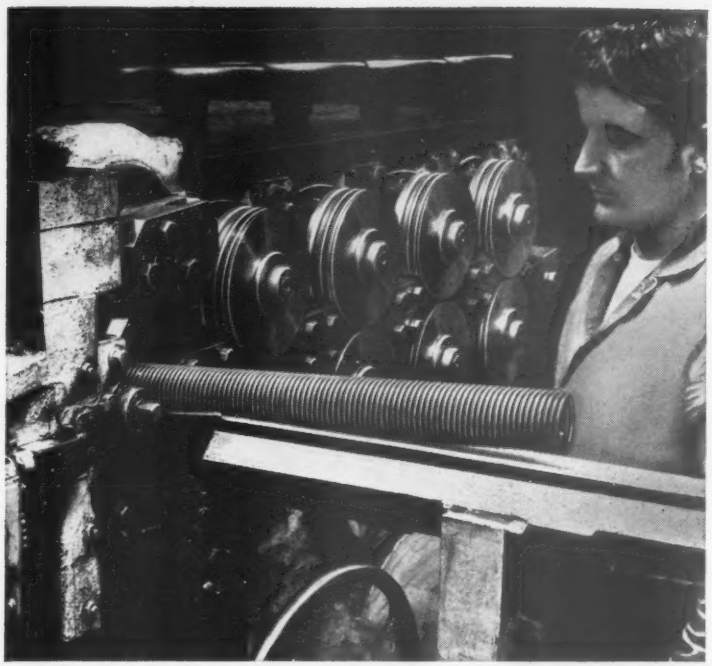
Meanwhile in the Spring Department springs are being coiled according to engineering formulas which take into account door weights, drum diameters and other factors. After coiling, each extension spring is tested to determine the number of pounds pull required by extending it a specified number of inches. This pull is machine stamped on a tag which is fastened to the tested spring.

For example, a 25-inch spring is extended to 67 inches and the pounds pull is automatically recorded.

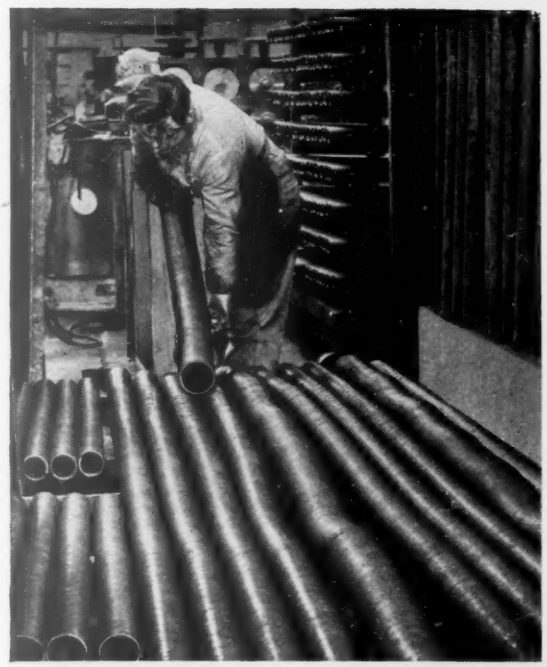
Engineering formulas tell the workers what weight springs to match with different doors. As a result, Ridge Door is able to assure its customers that doors will be in balance within five pounds.

Uniformity of oil tempered spring wire makes this precision work possible. Springs coiled from Pittsburgh Steel wire can be depended on for consistent performance.

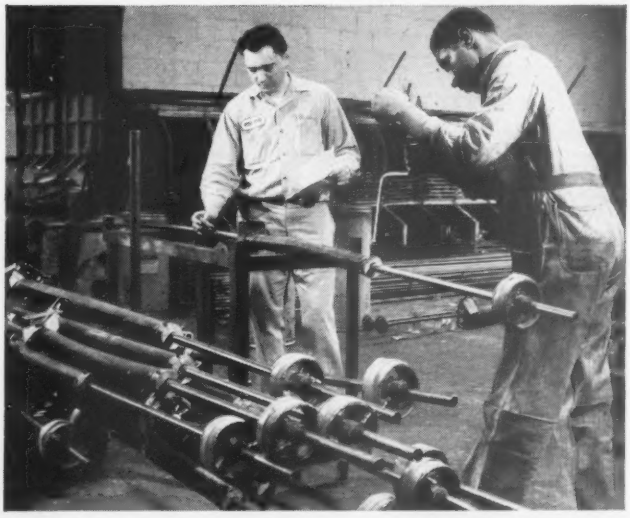
Coiling up to five tons of springs a day provides a tough test which



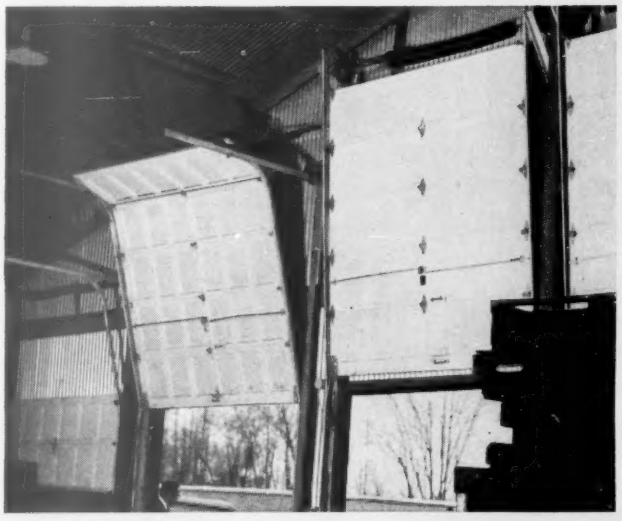
Uniform diameters and freedom from hard and soft spots speed spring coiling in the Monmouth Junction, N.J., plant of the Ridge Door Co. Division of Muskegon Motor Specialties Co. Pittsburgh Steel Co.'s oil tempered spring wire helps Ridge Door match springs to doors so precisely that finished product is in near perfect balance.



After coiling, springs are loaded into a two-unit, gas-fired furnace for heat treating. Springs are stress relieved for an average of 45 minutes at 475 degrees F. to achieve desired physical characteristics.



Assembling torsion springs on shaft. Each of these shafts will get two springs for use in raising a 16 by 7-foot double garage door. The springs shown here are coiled from wire .263 inch in diameter. The finished springs each have 120 coils. Drums and cables already are assembled.



A combination of high lift and vertical lift industrial doors produced with springs coiled from Pittsburgh Steel Co. wire is shown here. The installation is in the New Brunswick, N. J., warehouse of the Herman Forwarding Co.

Pittsburgh Steel wire passes.

Carmen Pellino, foreman of the Spring Department, puts it this way:

"We must have wire with uniform diameters, free from kinks as well as hard and soft spots.

"Variations in diameter prevent proper coiling since the wire will not pass through the rolls on the coiling machines properly. Soft and hard spots produce uneven coils and affect spring performance. We have found springs coiled from Pittsburgh Steel wire coil without trouble and perform well in service."

Other users of the wide range of wires for industry produced by Pittsburgh Steel get similar advantages. For improved production and greater customer satisfaction, call one of the district offices listed below. Real help is as close as your phone.

Pittsburgh Steel Company

Grant Building • Pittsburgh 30, Pa.

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Chicago	Dayton	Houston	New York	Tulsa
			Philadelphia	Warren, Ohio

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20,000 FEET PER MINUTE!*

Yes, here is America's most advance-design tinning installation Fully complete because it includes a supply stand, flux pot with dip rods and wipes, tinning tank with burner and automatic temperature control units, water cooling tank with recirculating pump and high-speed take-up that maintains constant linear speed. Remember, every part of this machine can be built to suit your own particular individual needs.

CHECK THESE FEATURES:

- Very flexible in its design
- Gives wire perfect uniformity
- Uses improved wiping method and dip rod construction
- Cannot produce rough wire
- Built of rugged, all welded parts
- Takes 12 to 20 lines or spools
- Up to 1000 ft. per minute speed
- Low initial investment

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*Using 20 lines of fine wire

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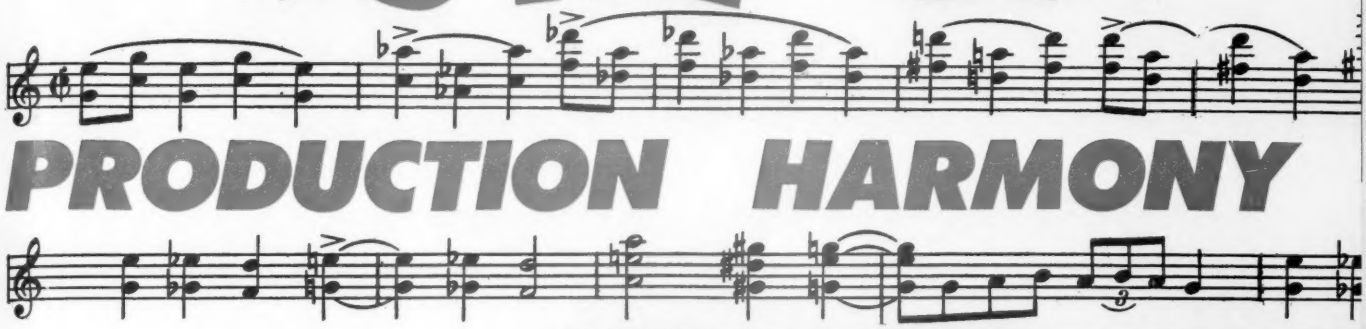
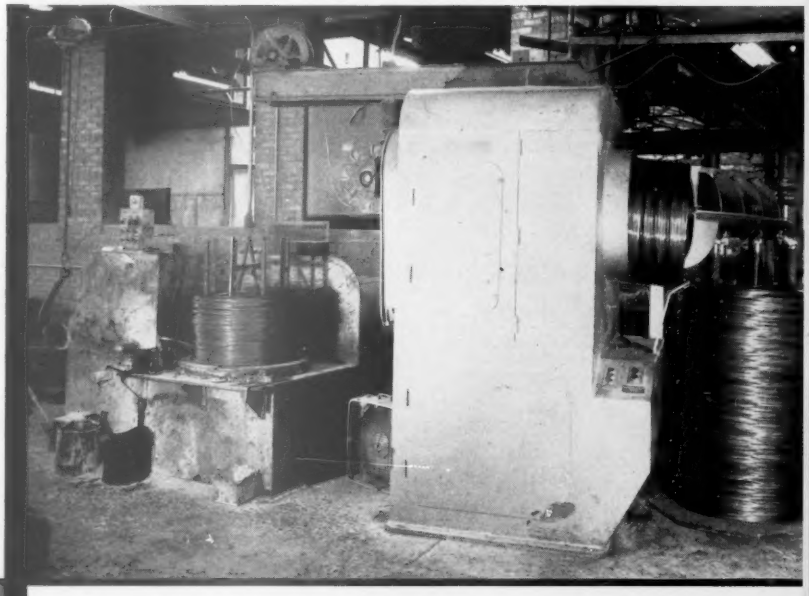

PRODUCTION HARMONY

With Whitacre

DEAD BLOCKS



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NOW AVAILABLE

New Whitacre Wire Drawing and Galvanized Dead Blocks — Proven in actual production to be the finest in performance and economy.

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"Cordially Invites You To Visit Our Chicago Wire Plant"

During the Wire Convention, you are welcome to visit our plant at your convenience. Wire machinery of every type will be in operation for your inspection.

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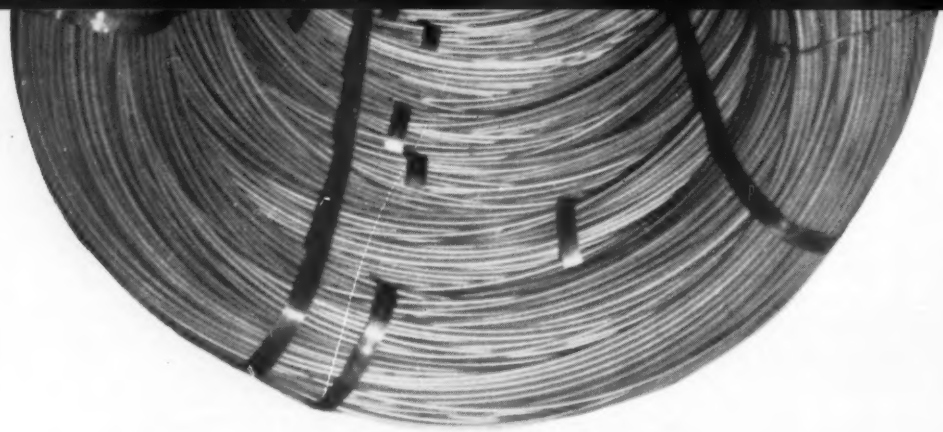

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for WIRE FLATTENING

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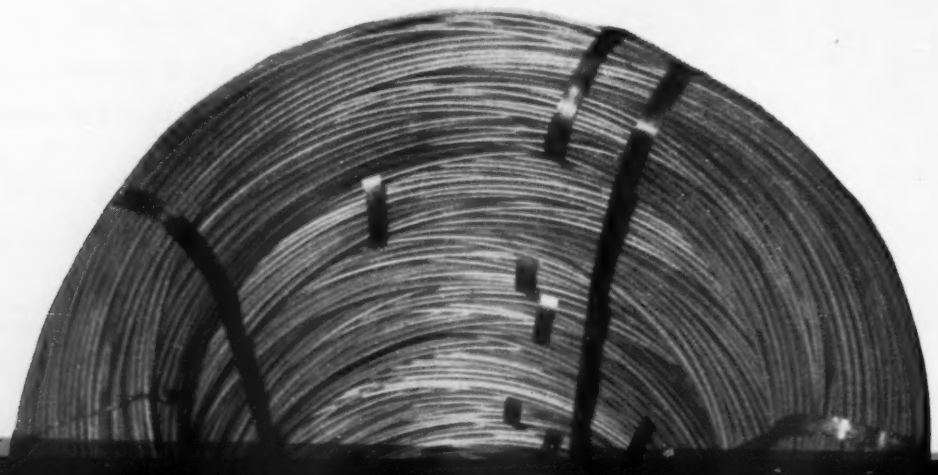
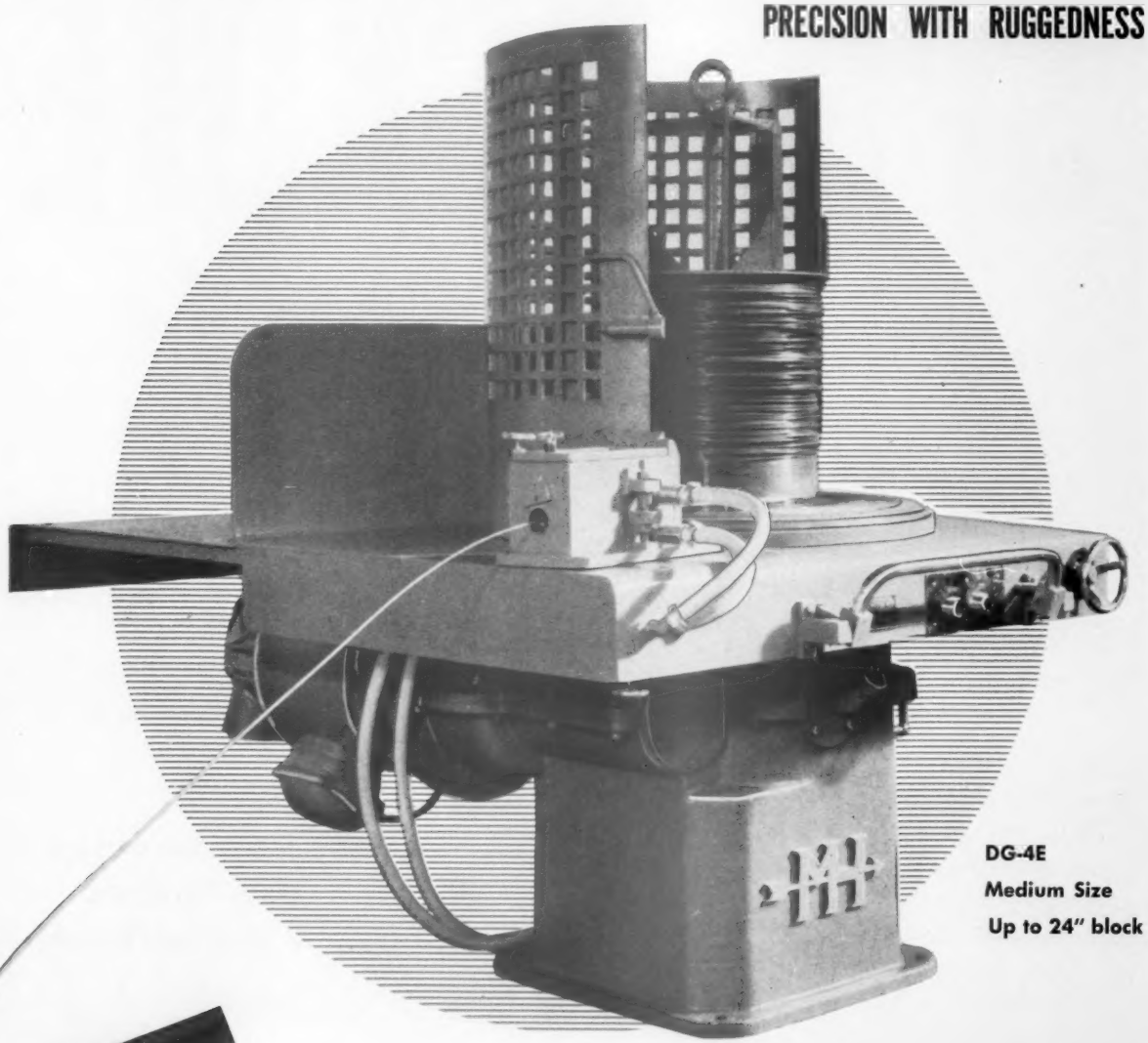


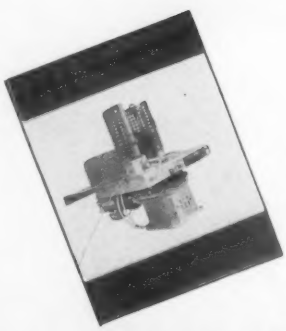
BULL BLOCKS

SINGLE or DOUBLE DECKED

PRECISION WITH RUGGEDNESS



DG-4E
Medium Size
Up to 24" block



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ROEBLING

SPRINGKOTE*

This new spring wire, upholstery grade, solves stress-relieving problems ◎ With Roebling Springkote Wire, burned-out electrical contacts and uneven heat distribution are problems of the past ◎ Springkote Wire paints better and runs smoother through coiling and knotting machines. All this for the same price as wire with the standard lime coat ◎ We don't mean to imply that lime-coated wire has faded into obscurity ◎ We're glad to supply it ◎ But we do urge you to look into the advantages of Roebling Springkote ◎ Customers who have run trial lots have been convinced and have switched to Springkote Wire for all their needs ◎ You can get the details by writing to Wire and Cold Rolled Steel Products, John A. Roebling's Sons Division, Trenton 2, New Jersey ◎

*Reg. App. for

WIRE

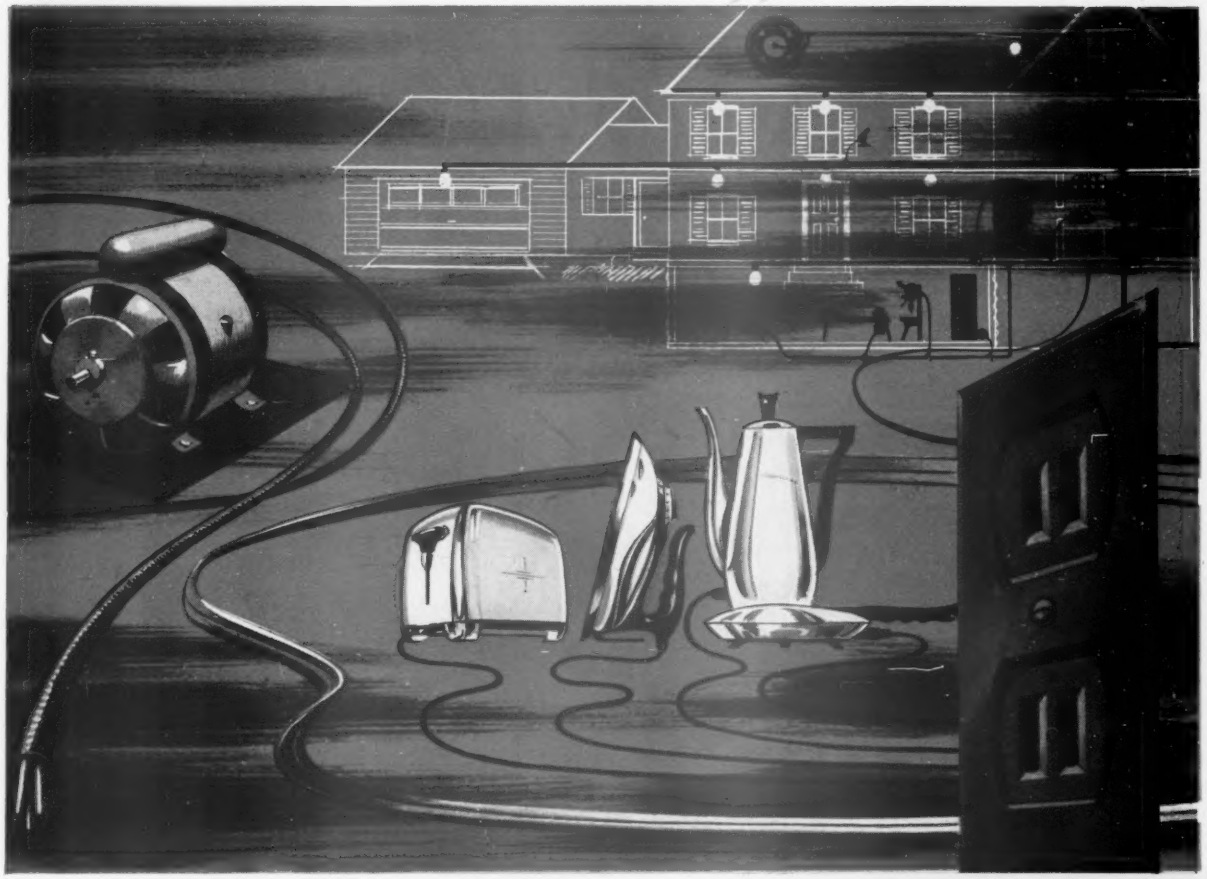
COSTS YOU NO MORE THAN LIME-COATED... ACTS A LOT BETTER

ROEBLING

Branch Offices in Principal Cities • John A. Roebling's Sons Division • The Colorado Fuel and Iron Corporation

Naugatuck MARVINOL

POLYVINYL CHLORIDE RESINS



four resins for electrical application

NAUGATUCK now offers the Wire and Cable Industry *more* PVC resins for insulation extrusion than does any other resin manufacturer.

Two of these Marvinol® resins, VR-22 and VR-23, have UL approval. These resins are, respectively, of high and intermediate molecular weight. Both have good dry blending properties.

Marvinol VR-24 and Marvinol VR-25 are resins of progressively lower molecular weights. They provide high volume resistivity in semi-rigid compounds with little or no plasticizer. Both deserve your careful evaluation for future electrical products.

Check with your Marvinol technical representative for complete data and evaluation samples, or write us on your firm's letterhead.

United States Rubber

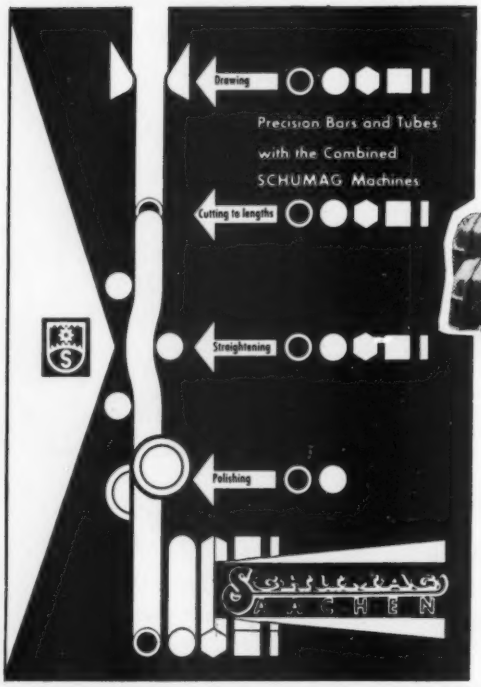
Naugatuck Chemical Division 1129-M Elm Street Naugatuck, Connecticut

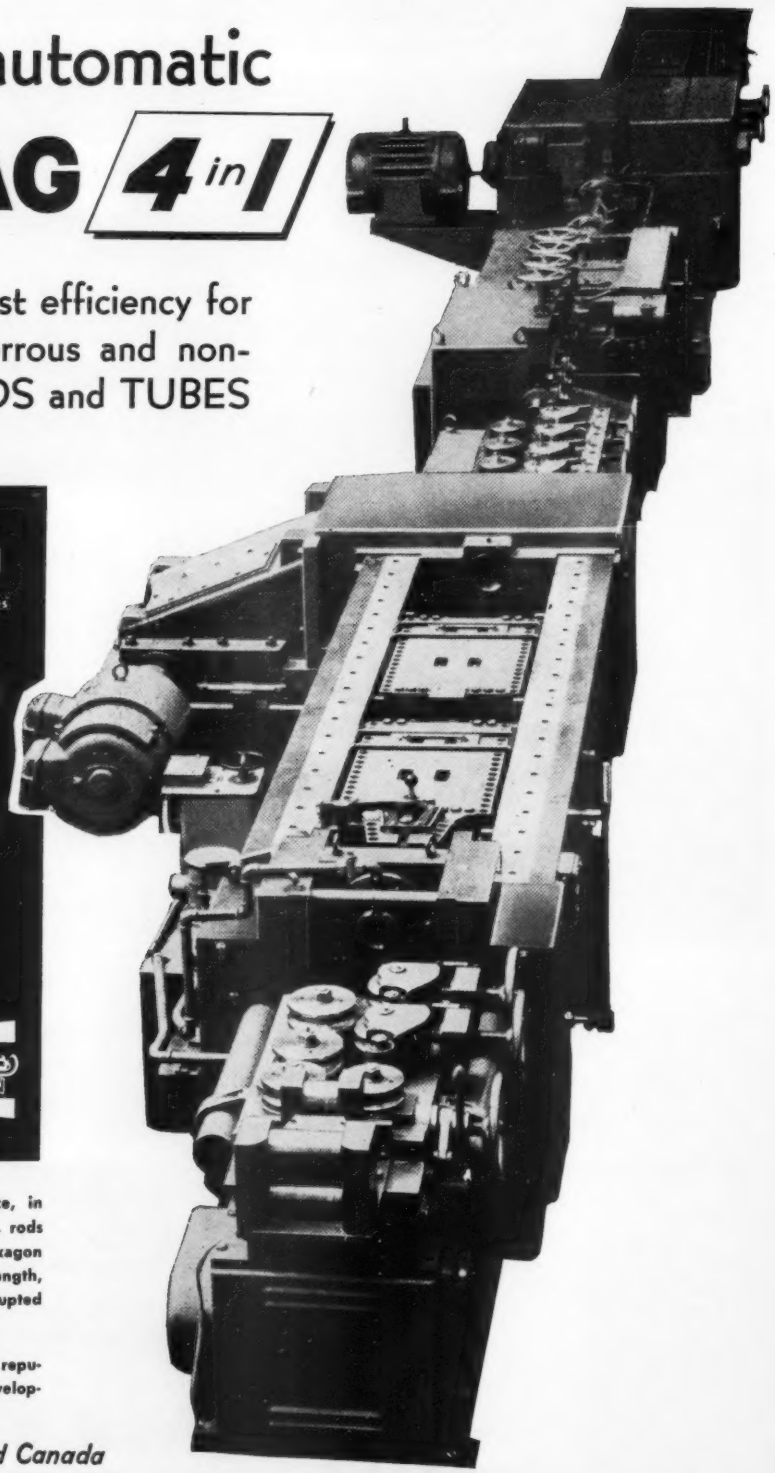
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices

DIST. OFFICES: Akron • Boston • Gastonia • Chicago • Los Angeles • Memphis • New York • Phila. • CANADA: Naugatuck Chemicals, Elmira, Ont. • CABLE: Rubexport, N.Y.

The fully automatic SCHUMAG 4 in 1

ASSURES... greatest efficiency for manufacturers of Ferrous and non-Ferrous BARS, RODS and TUBES





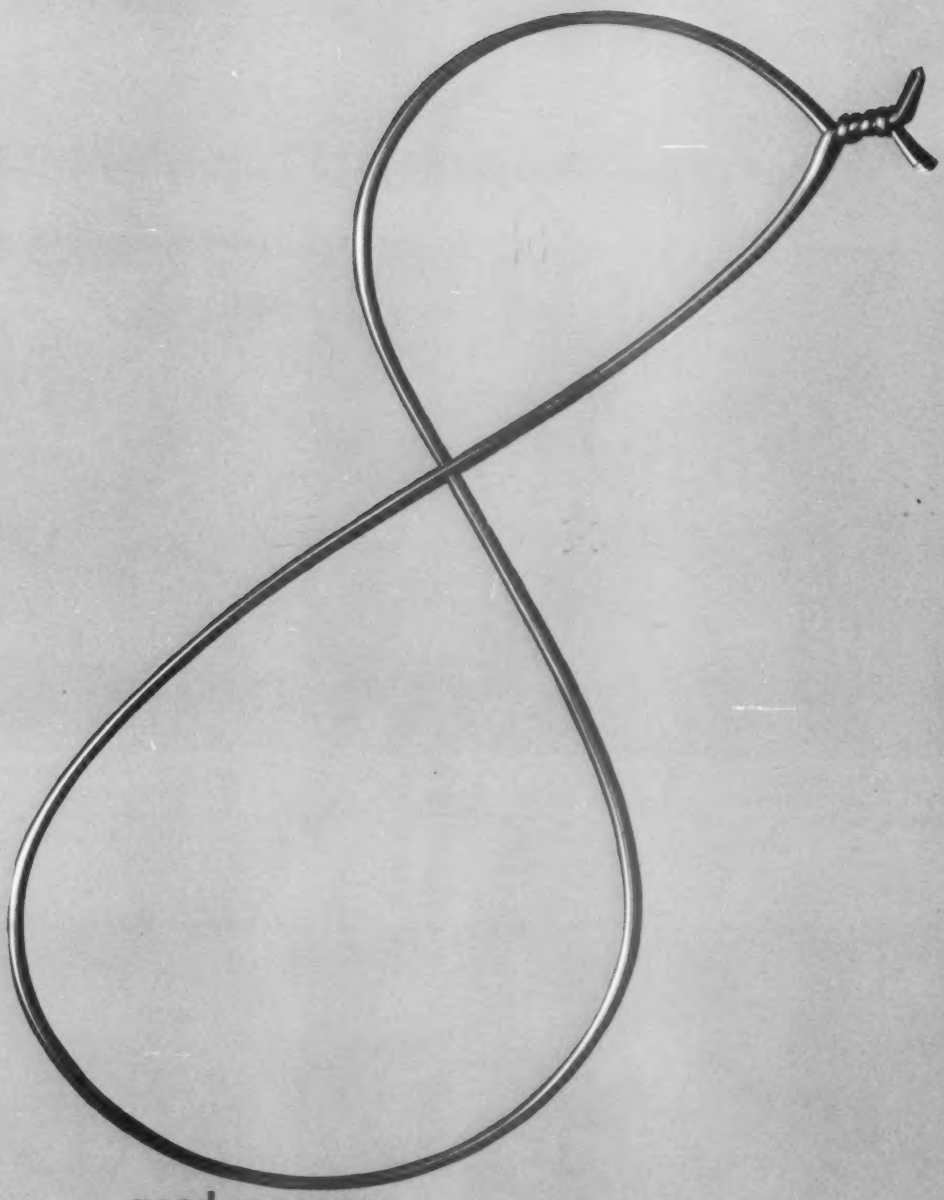
- SCHUMAG "4 in 1" machines produce, in one continuous operation, finished bars, rods and tubes from round, square or hexagon material. They will finish draw, cut-to length, straighten and polish in one uninterrupted sequence.
- SCHUMAG "4 in 1" enjoys world-wide reputation as the ultimate in technical development.

Exclusive Representatives for U.S.A. and Canada

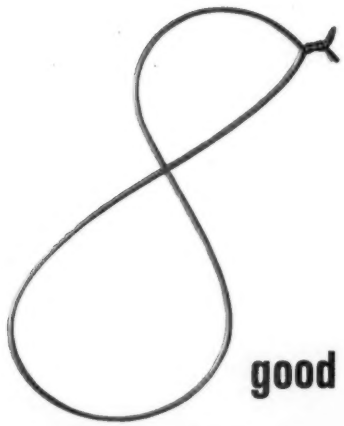
AMERICAN LAUBSCHER *Corporation*

Fisk Bldg., 250 West 57th Street, New York 19, N.Y.

SCHUMAG AACHEN



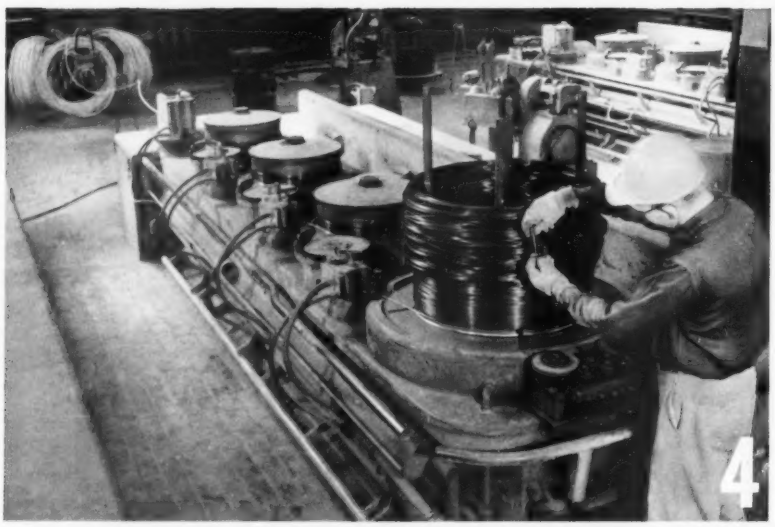
good reasons
why it pays to specify
American Steel & Wire
for all of your
stainless steel wire needs



good reasons why it pays to specify American Steel &

By using modern welding techniques, we can turn out continuous coil weights as heavy as 500 pounds to suit your particular needs. Heavier coil weights reduce down time on your machines, speed handling of material.

The latest in controlled annealing methods enable us to produce uniform properties in stainless wire that assure consistent performance on your equipment and in your product.



To insure the gage of your stainless is consistent from end to end, it's checked constantly during the continuous drawing process. ASW's wide range of modern, precision drawing machines can turn out everything you need in type, size and finish.

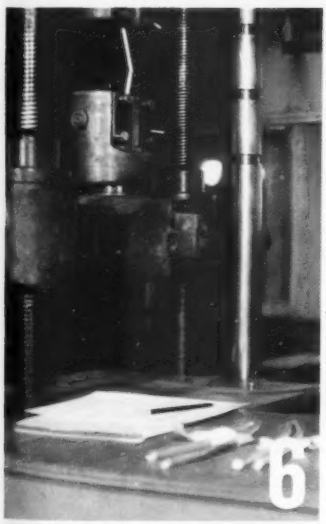
After drawing, the wire is again inspected to make certain that the gage and finish are exactly as specified.

This mark tells you a product is made of modern, dependable Steel.

Stainless Steel

& Wire for all of your stainless steel wire needs

Up-to-date salt and acid bath techniques and equipment guarantee the smooth, clean wire surface so important to the finished quality of your product. After cleaning, coatings such as this electrolytic copper coating are often applied to make your job of fabrication easier.



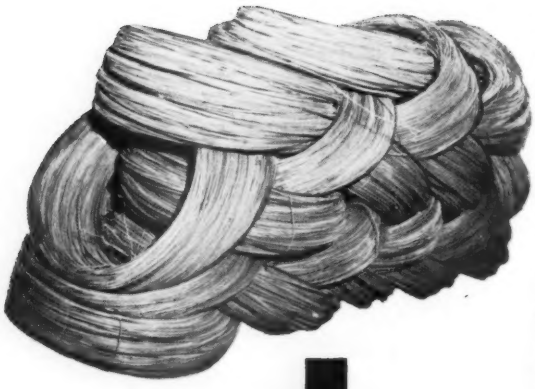
During processing and at finished size, our stainless wire is tested for tensile strength and other properties to make sure it meets specifications. Such tight control insures quality.

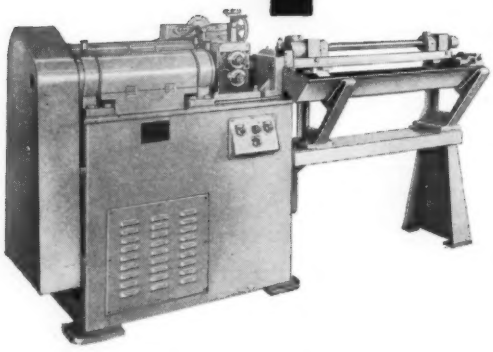
To insure supply and fast delivery, we stock 300 to 400 tons of cold heading stainless wire in addition to a heavy tonnage of other stainless steel wire items at all times.

8 Our stainless steel wire service is second to none. In addition to our regular salesmen, we have special Stainless Steel representatives in your area who have both engineering and mill backgrounds. They know metals, they know production. Their assistance can be invaluable to you in solving the really tough ones. Call your nearest ASW Sales Office today. If you like, we'll have a man out to see you at your convenience. Or if you prefer, write American Steel & Wire, Dept. 0386, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

USS **American Steel & Wire Division of United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, New York





Above is the ALL NEW SHUSTER 2AV infinite variable speed, automatic Wire Straightening and Cutting Machine

wire size range:
1/16" to 5/16" mild steel wire, 1/16" to 3/16" high tensile wire, 50 to 200 FPM.
Send for complete details today!

The RIGHT COMBINATION

for

LOWEST COST

Straightened and Cut Wire!

Savings with a SHUSTER

MATERIAL: Wire in coils purchased at lowest price.

STORAGE: Less floor space required than for storage of straightened and cut lengths.

DELIVERY: *When* you *need* it. Eliminates damaged wire waste.

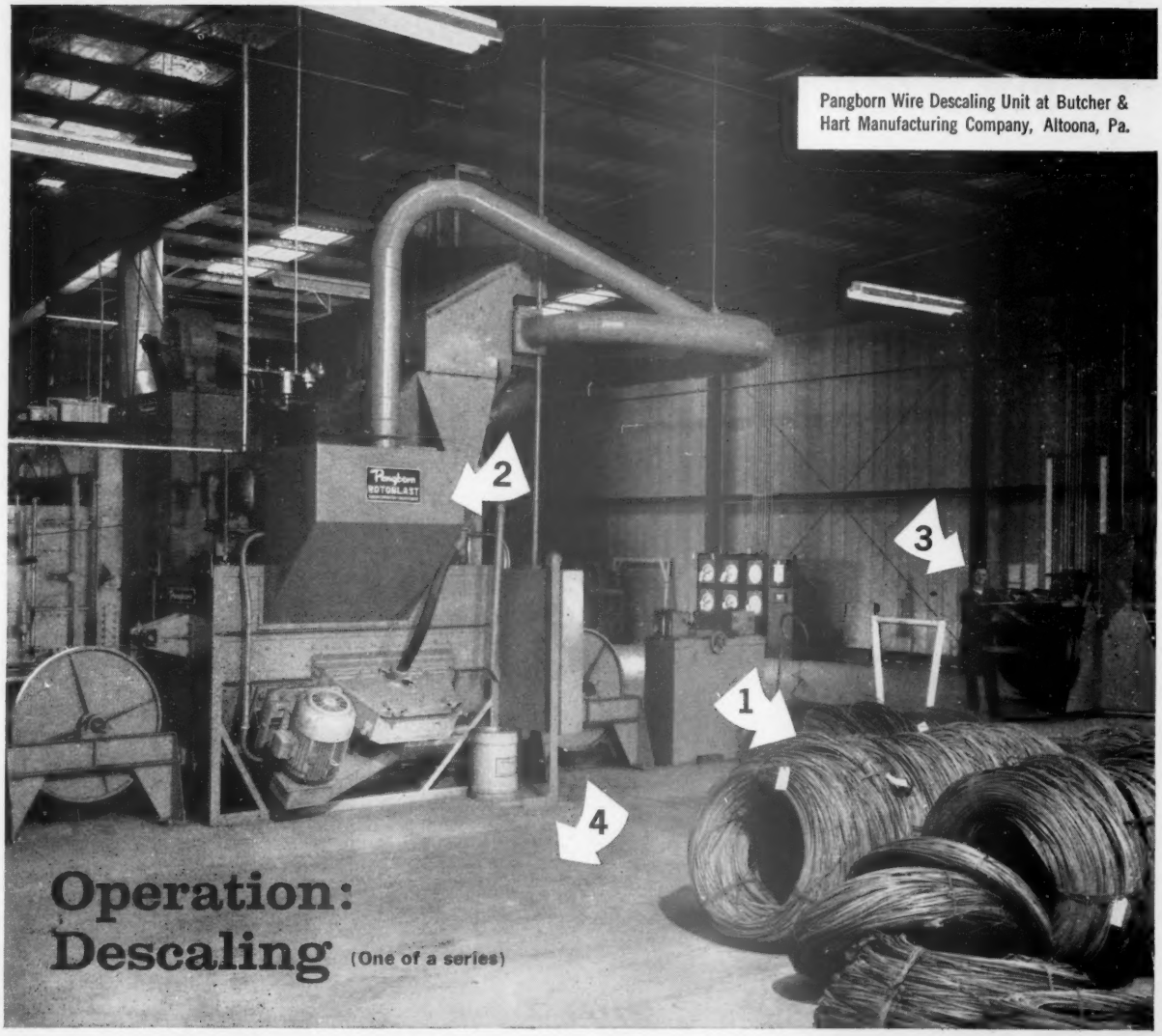
COST: SHUSTER is the oldest (1866), most dependable name in wire straightening and cutting. Always ahead with the best, *tested* machine refinements, SHUSTERS cost *less* than any comparable machine.

Send us your wire straightening requirements from .020" to $1\frac{1}{16}$" for quotation. Let us show you that a SHUSTER pays its way faster than any comparable machine!

Get the facts from one of our more than sixty representatives throughout the United States and Canada. There is one near you!

METTLER MACHINE TOOL, INC.

155 W. Adeline, New Haven, Connecticut



Q: Does Rotoblast end acid disposal problems?
A: Yes, and it cuts costs in the process.

1. Rotoblast eliminates loss of virgin metal

When wire and rod descaling is done through pickling, some virgin metal is invariably lost. Operating experience shows that there is no loss of virgin metal with Rotoblast Descaling. Also, there isn't any acid requiring disposal. Problems like water pollution are made obsolete in many areas of operation by Rotoblast.

2. Rotoblast reduces investments

With Rotoblast, savings on wire and rod descaling equipment can run as high as 70% on the original investment when compared with the investment required for pickling equipment.

3. Rotoblast minimizes descaling time

Wire and rod descaling goes faster with Pangborn Rotoblast than with pickling. Also, Rotoblast requires less manpower. Either way—or both—it cuts labor costs. (Following a patenting furnace, Rotoblast can descale multiple strands of wire, 40 or more at a time.)

4. Rotoblast frees space

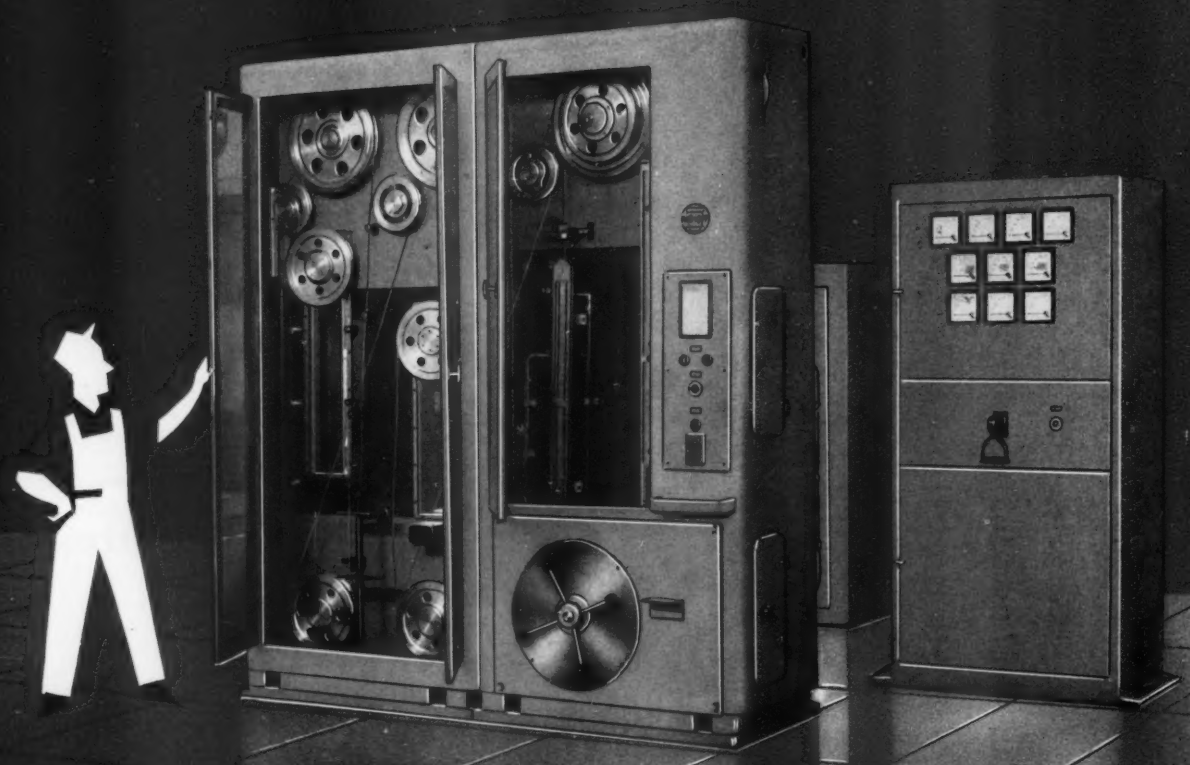
Since Rotoblast requires only ¼ to ⅓ as much space as pickling equipment, it frees the difference in floor space for other operations. Also, this airless-blast machine can be easily installed in line with coating and drawing equipment to provide straight-through production. Rotoblast-cleaned surfaces are ideal for any type of coating or for drawing compounds.

You, too, can effect considerable savings with the Rotoblast Descaling Unit in your wire and rod descaling operations. Talk with your Pangborn representative or write: PANGBORN CORPORATION, 5400 Pangborn Blvd., Hagerstown, Maryland. *Manufacturers of Blast Cleaning, Vibratory, Dust Control Equipment—Rotoblast® Steel Shot and Grit®.*

Pangborn
OF HAGERSTOWN

NEW DEVELOPMENTS CONTINUE!

Large Continuous Electric Annealer VG 85 to be worked in combination with any copper rod break down machine, for bright annealed finished wire, for sizes between .14" and .048". Finishing Speeds up to 3000 to 4000 ft/min.



AMERICAN LAUBSCHER Corporation
BLDG. 250 WEST 57th STREET
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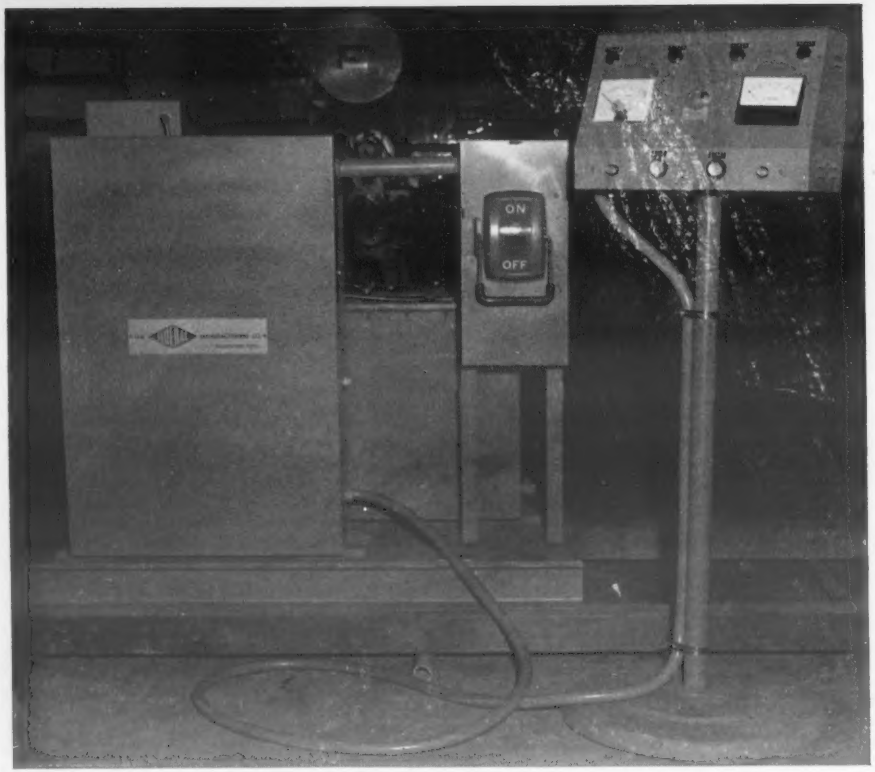
NIEHOFF

NIEHOFF MACHINE WORKS

SCHWABACH NEAR NURNBERG WESTERN GERMANY



FEDERAL AUTOMATIC TESTERS

FEATURING

- **Automatic to preset voltage**
- **Automatic testing cycle**
- **Current limiting**
- **Corona free (Optional extra)**
- **Remote control**

Available in the following models:

20 KVA	20 to 50 KV
25 KVA	25 to 50 KV
50 KVA	50 to 100 KV

Smaller models from:

2 KVA to 20 KVA

You are invited to secure detailed information on the above and other FEDERAL equipment

Telephone: CO 9-4213

Other FEDERAL Products

TESTING

Insulated Wires:
- SPARK TESTERS
- HIGH POTENTIAL TESTERS
- ELECTRONIC AC-DC

Magnet Wires:
- CONTINUITY TESTERS
- DIELECTRIC TESTERS
- ABRASION SCRAPE TESTERS

MACHINERY

- TAKE-UPS — 30" to 72"
- PAY-OFFS — 30" to 72"
- RE-REELERS — DUAL SHAFT
- CAPSTANS
- PAYOFF PAKS
- PLANETARY CABLERS
- COLLAPSIBLE REELS
- 2-3 WHEEL MEAS. MACHINES
- PREHEATERS

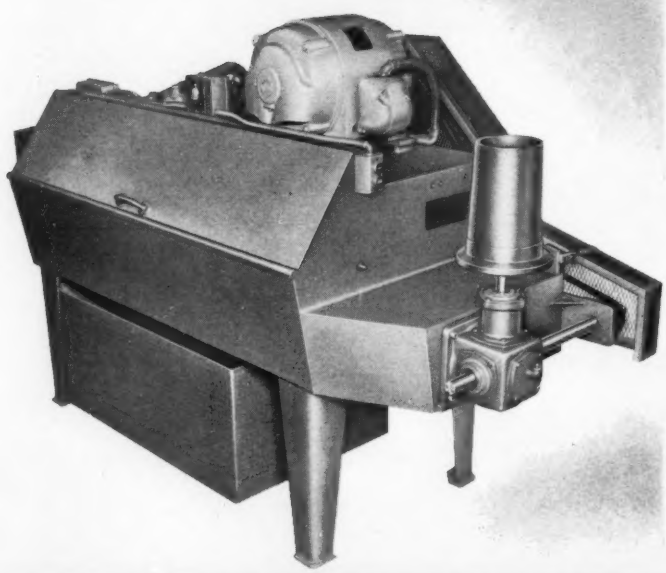
THE FEDERAL MANUFACTURING CO. WALLINGFORD, CONN.

WIRE MACHINERY • TESTING EQUIPMENT

FOUR ROLL TANDEM

WIRE DRAWING MACHINE

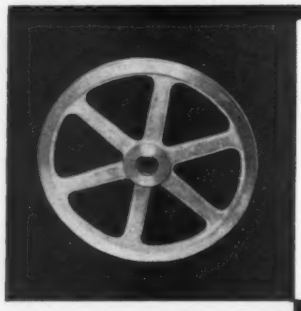
Step Rolls
Silent Chain Drive
Fabricated Frame
Circulating Cooling System



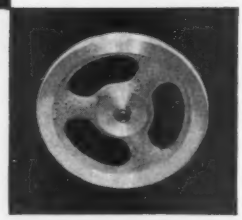
ROLLS
6-step 12-pass style, 12 inches major diameter. Machined Meehanite for good wear resistance and long operating life. Rolls are specially designed and driven so that slippage of the wire on the rolls due to wire elongation is a minimum.

FRAME
Extra heavy construction for good rigidity. All-welded fabrication of ½-inch and ¾-inch steel plate.

MAIN DRIVE MOTOR
10 to 30 horsepower, 220 or 440 volts, depending upon size and speed of wire to be drawn. Variable speed or geared motor. Belt or chain drive.



ALUMINUM SHEAVES



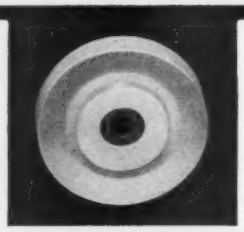
These Watkins Aluminum Sheaves offer outstanding advantages of ease of maintenance and long service life when used in gangs to guide wire through enamelling ovens and related equipments. Each sheave is machined from an aluminum casting.

	SMALL	LARGE
V-GROOVE ROOT DIA.	3¾"	8"
SHAFT SIZE	¼"-5/16"-⅜"	⅝"
WIDTH	¼"	3/16"
SHAFT MOUNTING	Oiled bushing	Needle bearing

Large sheave is available with single or double groove.

NYLON

IDLER PULLEY



The Watkins Nylon Idler Pulley combines the resiliency, high strength and low weight of nylon with the free-turning ball bearing to give outstanding performance wherever pulleys are used in fine wire drawing machinery.

SIZE:
1½" O.D. x 3/16" Wide
SHAFT SIZE:
3/16" Diameter
STYLE:
Single groove
Double groove

Other styles available to suit individual application.

RS WIRE MACHINES

Descriptive literature is available. Inquiries are invited.

R. S. WATKINS & SONS, INC. Glen Road, Sandy Hook, Conn.

Radiant tube galvanizing pot handles 4000 lbs. per hour. Vent picks up combustion gases after they pass over strands, drying and preheating them.

Wickwire Spencer is latest major wire producer to change to Lee Wilson Radiant Tube Galvanizing

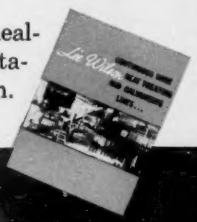
PREHEAT AND TANDEM LEAD SETTINGS DESIGNED FOR COMPACTNESS AND FLEXIBILITY. Wickwire Spencer Division of The Colorado Fuel and Iron Corp. is another of the major wire producers to change to Lee Wilson Radiant Tube Lead Annealing and Galvanizing Lines to get maximum efficiency at lowest possible maintenance costs.

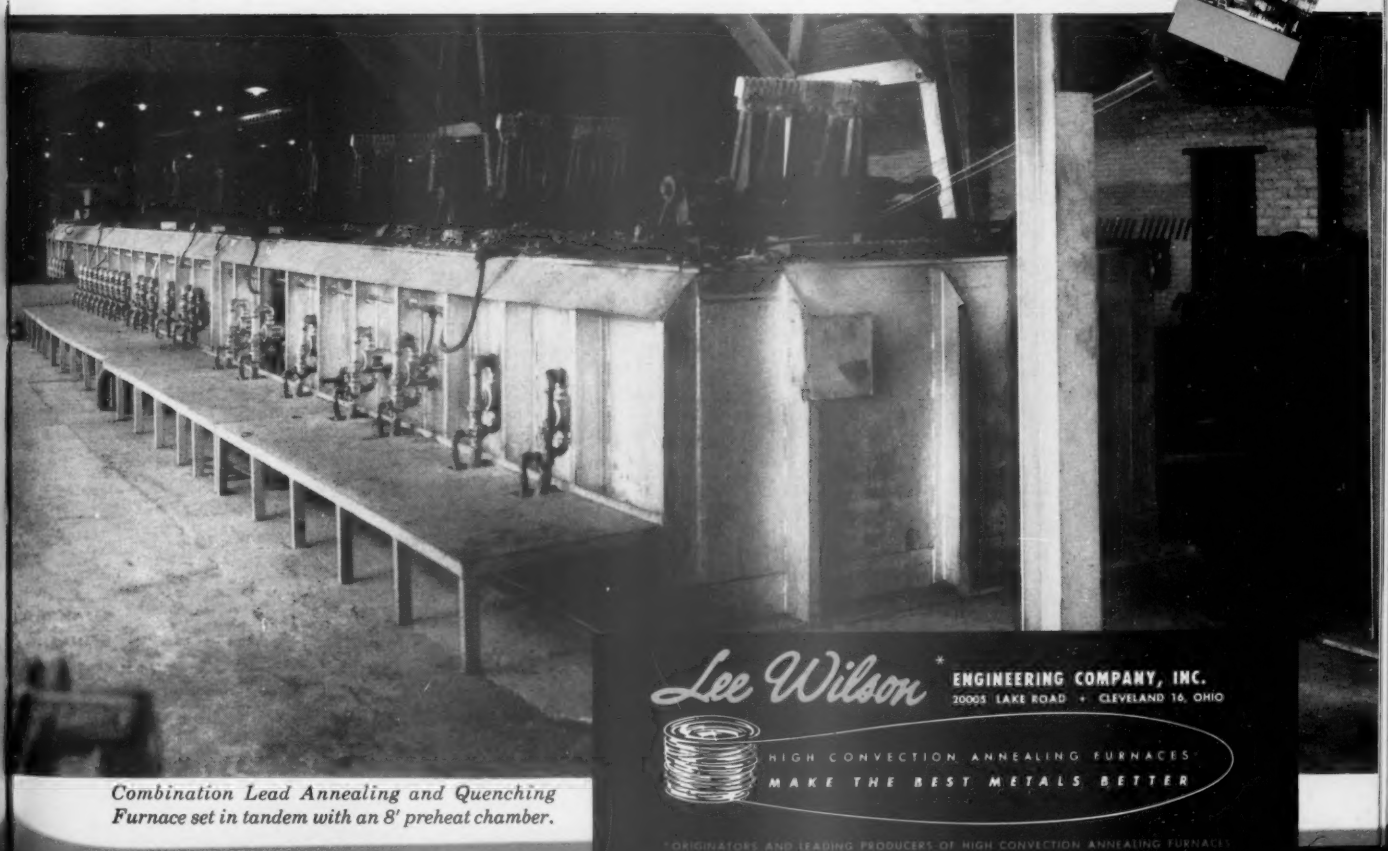
The Wickwire Spencer line includes a preheat chamber, high temperature lead furnace and lead quench set in tandem, and the galvanizing pot—all radiant tube fired. Combustion exhausts from the galvanizing pot are utilized to dry and preheat the wire for galvanizing.

The compact unit is capable of producing 3500 lbs. per hour when used for lead patenting, or 5000 lbs. per hour for lead annealing.

Radiant tube heating assures longer pot life, less dross and reduced fuel consumption.

For the latest information on wire patenting, annealing or galvanizing, contact your Lee Wilson representative or write direct for your copy of our new bulletin.





Combination Lead Annealing and Quenching Furnace set in tandem with an 8' preheat chamber.

Lee Wilson ENGINEERING COMPANY, INC.
2000S LAKE ROAD + CLEVELAND 16, OHIO

HIGH CONVECTION ANNEALING FURNACES
MAKE THE BEST METALS BETTER

ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNACES

WIRE and WIRE PRODUCTS

reaches many prospects

YOUR SALESMEN DON'T KNOW!

No matter how big you are, the odds are you don't know all your actual prospective customers.

If your company is small, it is even more important to be "calling" on your prospects and customers regularly through advertising.

Your advertising in Wire and Wire Products will be seen by many people in the plants you wish to "sell", whom your salesmen never would see, yet who specify, actually buy or who influence decisions on products to be purchased. Your advertising is bound to be of immeasurable value to you, too, in paving the way for a good reception for your salesmen when they do call. And the field's buying power is tremendous!

WIRE AND WIRE PRODUCTS circulation is all paid. We have no agents, offer no premiums nor make special inducements to get circulation, except the value of the editorial contents in itself—yet our renewals have averaged 97% or better for many years. That's why it is a good and forceful advertising medium for all concerns who have products to sell to this vigorous and progressive industry.

———— • ————

Subscribers by Types of Mills in the Industry

1.	Rod, Bar and Wire (producers of rod, bar and wire in all metals and shapes)	38%
2.	Forming and Fabricating Plants (mfrs., largely from purchased wire, of springs, wire cloth, bolts, nuts, screws, rivets, wire forms, fences and fencing, wire specialties, wire rope and electric wire and cable)	59%
3.	Miscellaneous—Libraries, Research Organizations, Jobbers, Distribution, etc.	3%

Subscribers by Types of Positions Held

1.	Executives: Presidents, Vice Presidents, Secretary-Treasurers, Purchasing Agents, Sales Managers	22%
2.	Operating: Vice Presidents, General Managers, Works Managers, Superintendents and Assistant Superintendents.	58%
3.	Research and Maintenance: Plant Engineers, Metallurgists, Laboratory Technicians, Foremen and Inspectors	19%
4.	Libraries	1%

———— • ————

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WIRE and WIRE PRODUCTS

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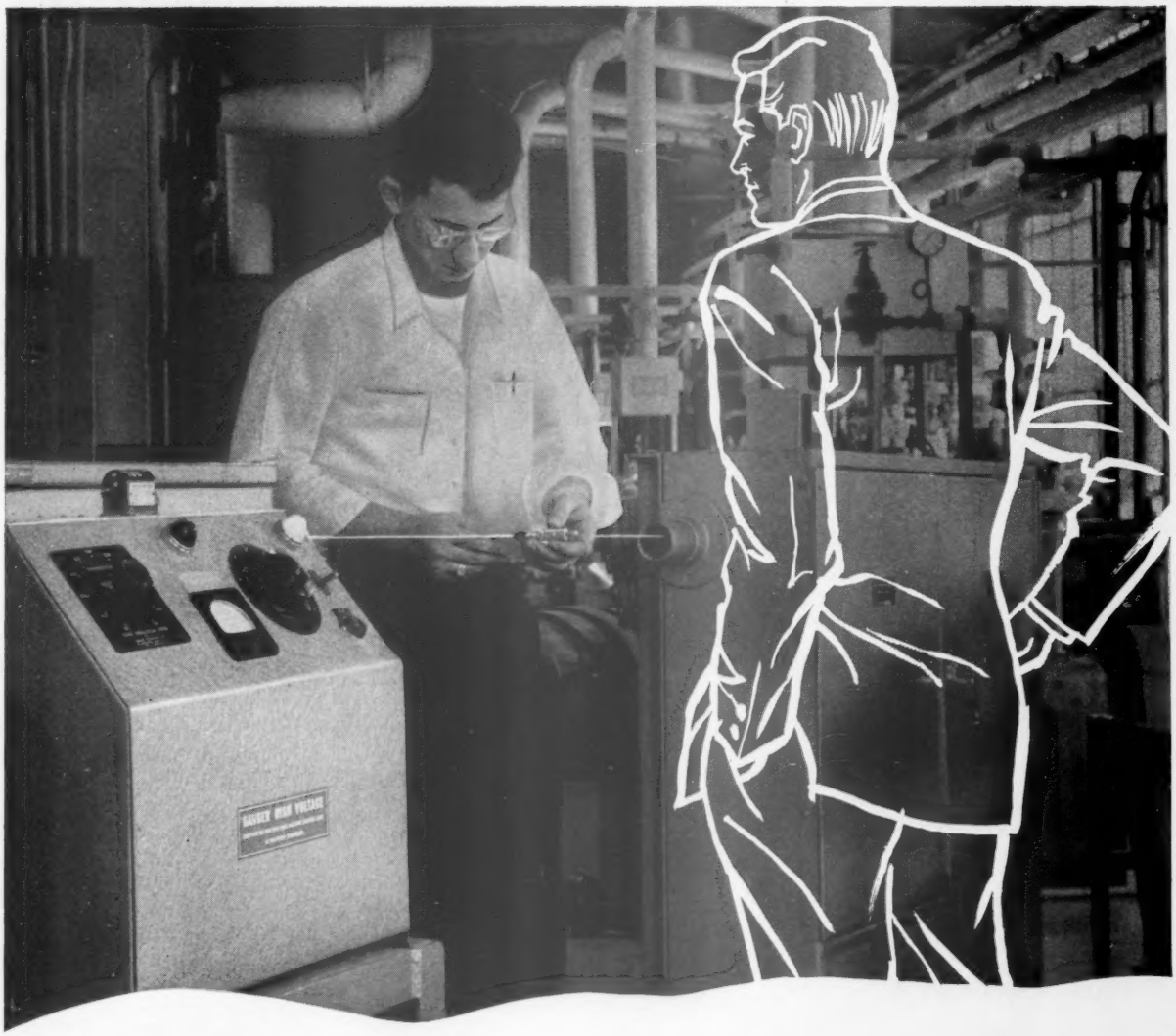


TWO NEW SOLUTIONS FOR "HOT" WIRE PROBLEMS
...FROM YOUR SILICONES MAN

Two new low shrink silicone rubber insulating compounds... developed by the UNION CARBIDE Silicones Man... are now solving many of today's electrical wire and cable insulation problems. Offering good dielectric and physical properties with easy processing, they are ideal materials for air frame applications, motor truck wires, motor leads and hook-ups, small appliance wiring, and marine wiring.

UNION CARBIDE K-1347 Silicone Compound is a premium quality stock that meets tight military and industrial specifications. It has high green strength, remilling is easy, and it is readily colored for coding. Easily extruded, it provides a smooth, non-porous, high gloss surface, and can be braided without postcure. Physical properties are excellent using either steam or hot air cures.

For economy operations where good, but not premium, physical properties are needed, lower cost UNION CARBIDE K-1357 may well fill all requirements. Available precatalyzed in both slabs and coiled strips, it can be fed directly from carton to extruder on most equipment.

Both silicones have outstanding retention of tensile strength and elongation after prolonged exposure to high temperature. Both have dielectric strength of 1000 volts/mil. Both can be cured with either steam or hot air. And both are low shrink compounds. K-1347... for premium properties. K-1357... for economy.

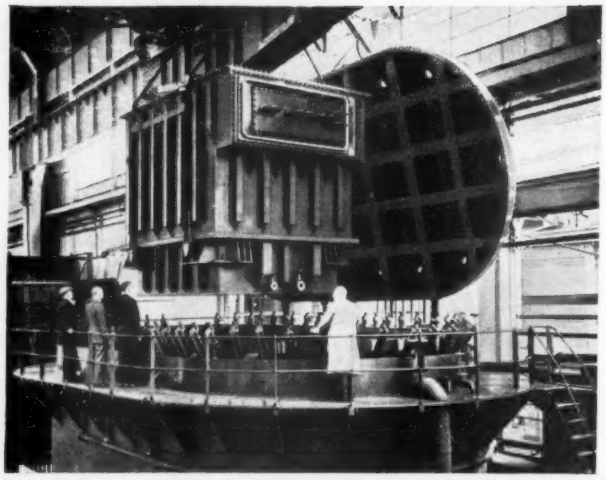
For more information, write or call your UNION CARBIDE Silicones Man, or Dept. KZ-9905, Silicones Division, Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *(In Canada:* Bakelite Company, Division of Union Carbide Canada Limited, Toronto 12, Ontario.)

Unlocking the secrets of silicones

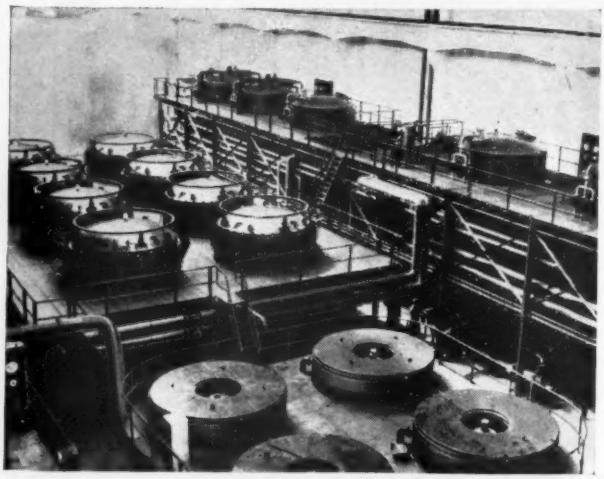
Rubber, Monomers, Resins, Oils and Emulsions

UNION CARBIDE **SILICONES**

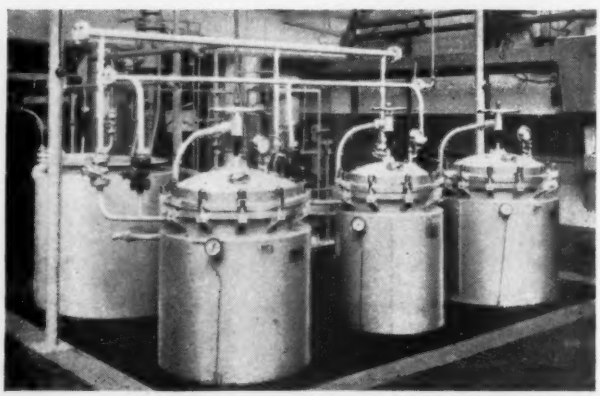
"Union Carbide" is a registered trade-mark of UCC.



High Vacuum Drying and Treatment Vessel for Large Power Transformers.



High Vacuum Mass Impregnating Plant for Super-Tension Paper Insulated Power Cables.



Versatile High Vacuum Plant with Separate Impregnators for use with Various Impregnants.

High Vacuum Drying and Impregnating Plant

We design and manufacture plant for use with all classes and types of impregnants. Our range covers modest plant for the small electrical repair shop up to complete schemes for the treatment of the largest sizes of power transformers, generators and power cables.

Full information will gladly be supplied on request.

GENERAL

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Why utility engineers now specify

POWER CABLE INSULATED WITH MONSANTO POLYETHYLENE

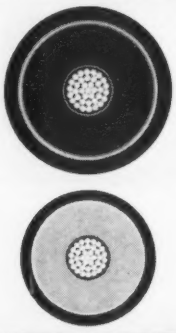
• better abrasion resistance • lower power factor; less power loss in transmission • low surface tracking • excellent moisture resistance • less bulk, less weight

Leading manufacturers now produce power cable insulated with polyethylene based on Monsanto Polyethylene resins, specially developed and perfected by Monsanto. For complete technical data including applicator's information, write to Monsanto Chemical Company, Plastics Division, Room 730, Springfield 2, Massachusetts.

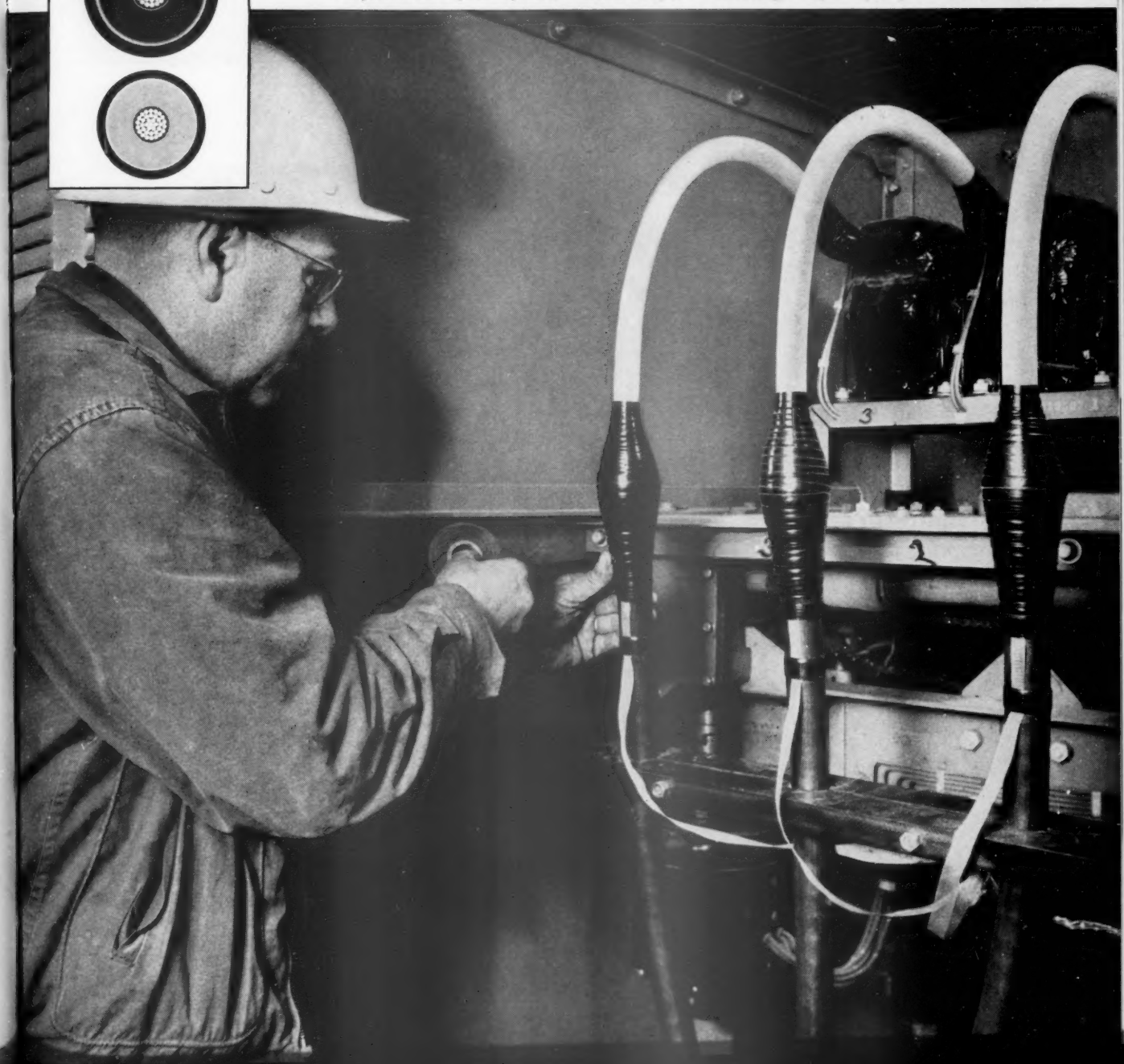
Monsanto®

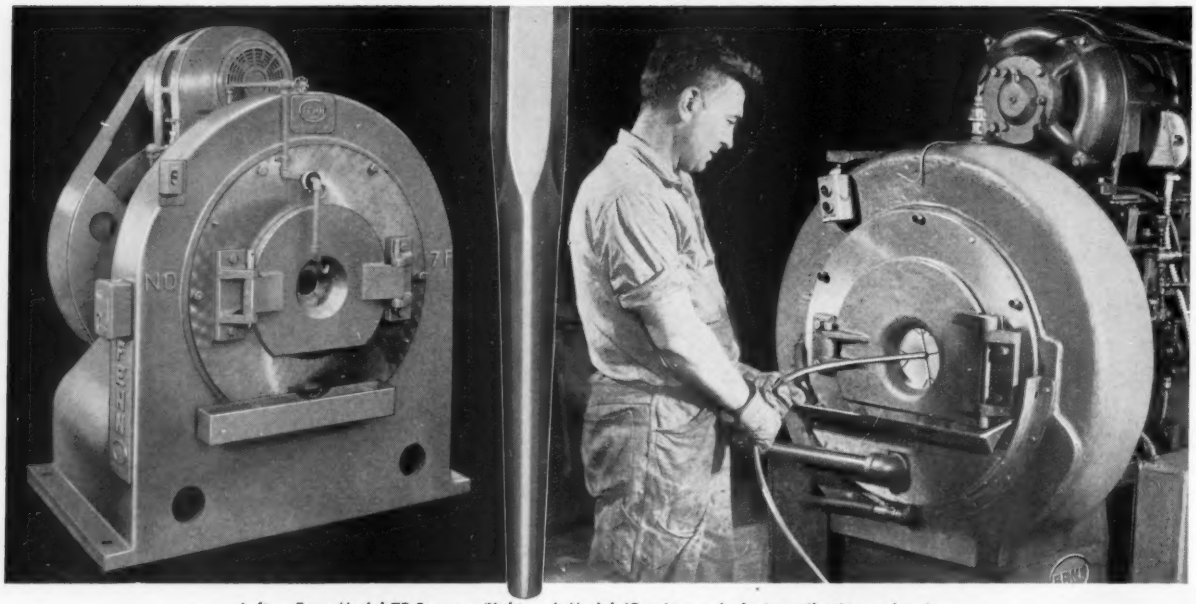
MONSANTO ACTIVATOR IN PLASTICS

Note the slim shape and size of the polyethylene-insulated cable (lower), compared to the old cable (upper) being replaced.



New 15,000 volt polyethylene-insulated power cable installation at main sub-station, Monsanto Chemical Co., Plastics Division plant, Springfield, Mass. Installation-rated at 175 amps, 15,000 volts. 3-phase system, 1 conductor per phase. Conductors are 2/0-37 strand copper (133,100 circular mils). Insulation consists of: 1 layer semi-conducting tape, 297 mil polyethylene insulation, 1 layer non-metallic tape, metal shielding, 1 layer tape, 6/64″ vinyl jacketing.





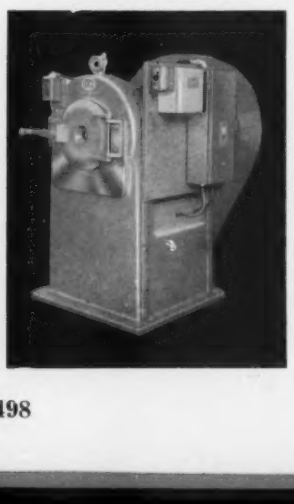
Left — Fenn Model 7F Swager. *Right* — A Model 6F points end of wire coil prior to drawing.

Wire Pointing with FENN Swaging Machines

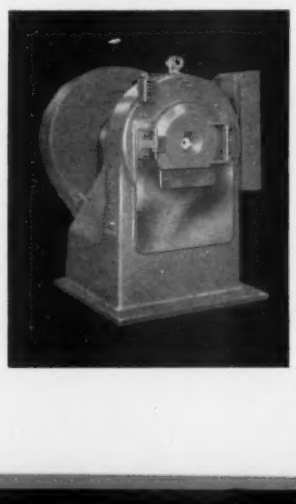
The wide preference in the wire industry for Fenn Swaging Machines for primary pointing prior to drawing can be attributed to their ability to produce heavy reductions with dependability and with minimum maintenance. From the rugged one piece solid meehanite frames to the precision machined roll cage assemblies, Fenn Swagers are engineered and built to deliver under heavy production schedules. Only Fenn makes all types of swaging machines . . . in a complete range of sizes that will swage solids from 5/32" to 3-3/8" . . . and in 2-Die or 4-Die models. A complete line of manual and hydraulic feeds greatly increase the Swager's productivity and accuracy . . . with far less operator fatique. We invite you to consult with our swaging engineers.

The Fenn Manufacturing Company, Newington, Conn.

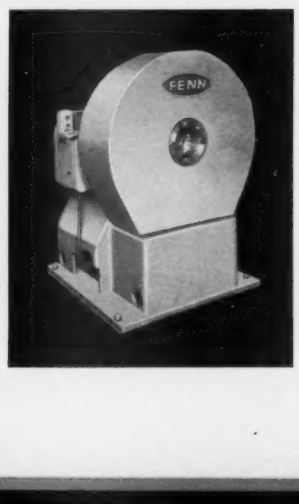
Rotary 2-Die



Rotary 4-Die



Stationary Die



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TO FORM COMPLICATED WIRE & RIBBON METAL PARTS

NILSON 4 SLIDES
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DESIGN & TOOLING HANDBOOK
Wire and Ribbon Metal Forming FOURSLIDE Machines
THE A. H. NILSON MACHINE COMPANY
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If you are looking, it will pay you to investigate NILSON Fourslide Forming Machines, which can handle wire diameters from 0.010″ to 0.5″ (feed lengths to 32″) and ribbon stock up to 4″ wide (feed lengths to 24″). And, parts can be produced at rates over 400 per minute.

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For the first time, a NEW—"FOURSLIDE Design & Tooling Handbook" explains many important aspects of the FOURSLIDE PROCESS. It will help you in product design, in methods engineering, and in tooling. The HANDBOOK describes design aspects of parts formed on a FOURSLIDE; Drawings and descriptions of tooling design using actual examples; How to combine operations, such as stamping and forming, cut-off, forming and welding, or forming and assembly. Many other facts also given.

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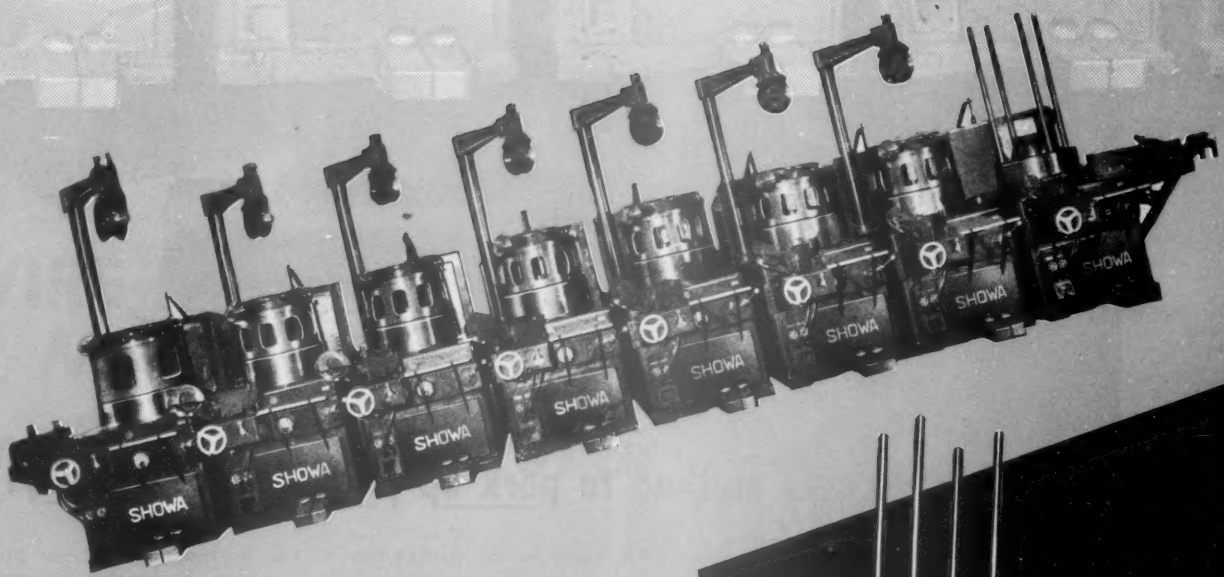

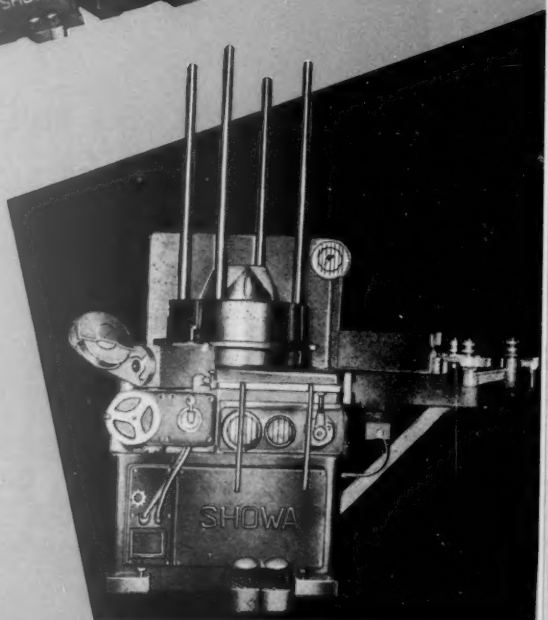

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SHOWA MACHINE WORKS LTD.

No.16. Naka 3-chome, Mitezima, Nishi-Yodogawaku, OSAKA JAPAN

Metallurgical Memo from General Electric

"MOVING METAL" with Carboloy® cemented carbides

The best known method to perk up production efficiency!

HOW CARBOLOY QUALITY PAYS OFF . . .

- maintains calculated accuracy longer
- more production per die

The product is given:

- better grain structure . . . better finish
- less waste—fewer rejects

This could be the perfect time to take a fresh look at your production picture. Every day, manufacturers are discovering the multiple "pay-off" derived from General Electric Carboloy quality cemented carbides . . . designed to "move metal" at *lower cost*, with *less* waste.

But that's only part of the picture. They have learned from experience that General Electric metallurgists have given them carbides second to none in quality . . . in standard or special dies for wire, bar and tube forming. The sustained accuracy of the work output . . . the finer finish of the end product and productive life of the dies are proof-positive of Carboloy superiority. Your authorized Carboloy Die Distributor or Die Maker can help you "move metal" at lower cost. Call him today. Metallurgical Products Department of General Electric Company, 11171 E. 8 Mile Road, Detroit 32, Michigan.

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METALLURGICAL PRODUCTS DEPARTMENT

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CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

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WIRE DRAWING MACHINES

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TYPE GII NON-SLIP WIRE DRAWING MACHINE FOR *BASIC* STEEL WIRE ARRANGED IN TANDEM. COMPACT MODERN DESIGN.

Simple operation is the keynote of Herborn Wire Drawing Machines. There are no clutches to operate and, by pushing starter buttons, the whole machine is put into operation. The machine is designed for the high speed drawing of low, medium and high carbon spring wire with starting sizes from ¼" diameter, as well as non-ferrous wires of suitable diameters. Herborn GII Machines can be equipped with type MEA II Mechanical descaling and coating units.

Write for catalog and detailed information to:

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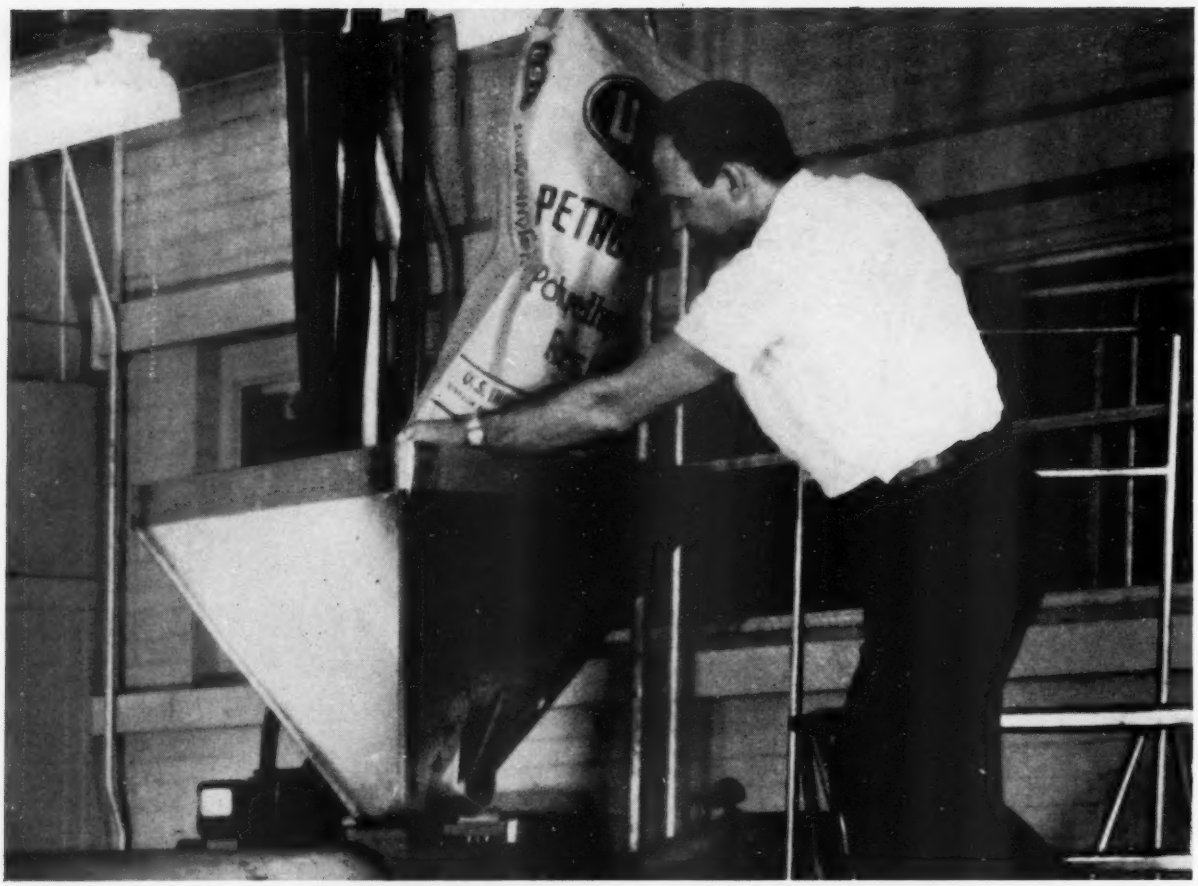
● ***Complete information on request. We will be happy to submit suggestions and proposals for your specific needs.***



You charge the resin as received when you produce polyethylene-covered wire

because polyethylene needs no blending

Manufacturing polyethylene-covered line wire is simple. You feed the resin, as you receive it, to the extruder. There are no plasticizers, softeners, antioxidants to add. There's no prebatching, blending, milling; no vulcanizing after extrusion. Carbon black and antioxidants are already in the resin.

A complete polyethylene production program simplifies operations in other ways too. One production line can take the place of several, providing savings in equipment, floor space, maintenance and labor. Stocking only one material reduces purchasing and inventory problems.

With polyethylene, you base production on a material that has trended downward in price as capacity increased. And ample capacity for PETROTHENE® polyethylene insures continuous supplies of uniformly high-quality resin.

Look To Tomorrow's Sales

See how polyethylene can improve the profitability of your operations tomorrow, if not today. With other insulating costs trending upward, polyethylene can be expected to be your most profitable line wire coating in the years to come. You can prepare for those profits *by promoting polyethylene-covered line wire now*, just as U.S.I. is doing in a series of advertisements in utility magazines.

For your customers, polyethylene means a product that is easy to handle . . . has exceptional weather and stress-crack resistance . . . is long-lasting in service. This tough plastic covering is registering outstanding service records for power cable, communications cable, WD-1 infantry field wire, TV lead wire and many other applications.

U.S.I. PETROTHENE polyethylene resins are tailored to provide the proper balance of properties needed in different end uses. To help you choose the most suitable resin for each use, we've compiled a chart of the properties, applications and applicable specifications of PETROTHENE polyethylene compounds. This information is in a new four-page data sheet, "PETROTHENE Resins for the Wire and Cable Industry." Also available is U.S.I.'s comprehensive 100-page "PETROTHENE Polyethylene . . . A Processing Guide." Write for your copies.

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KEYSTONE MB SPRING WIRE STUDY

Western Newell Mfg. Co. also supplies a complete line of drapery hooks made from Keystone Forming Quality Wire.

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depends on KEYSTONE WIRE in the production of low-cost spring sash rods

To mass produce low-cost items that sell by the millions to retail stores coast to coast, calls for a quality product with top eye appeal for customer acceptance. Western Newell Mfg. Co., Freeport, Illinois, branch of The Newell Companies, manufactures many such items, including the spring sash rod illustrated. Keystone Drawn Galvanized MB Spring Wire permits continuous, mass-production runs without rejects . . . essential for profitable operation.

Says John H. Hepner, Purchasing Agent for Western Newell, "Keystone helps us produce a better sash rod through their close cooperation in developing and maintaining a wire most suitable for our use."

The most important requirements for manufacturing their sash rod are uniformity of temper throughout the coil, plus the superior silver brite luster of Keystone Drawn Galvanized MB Wire.

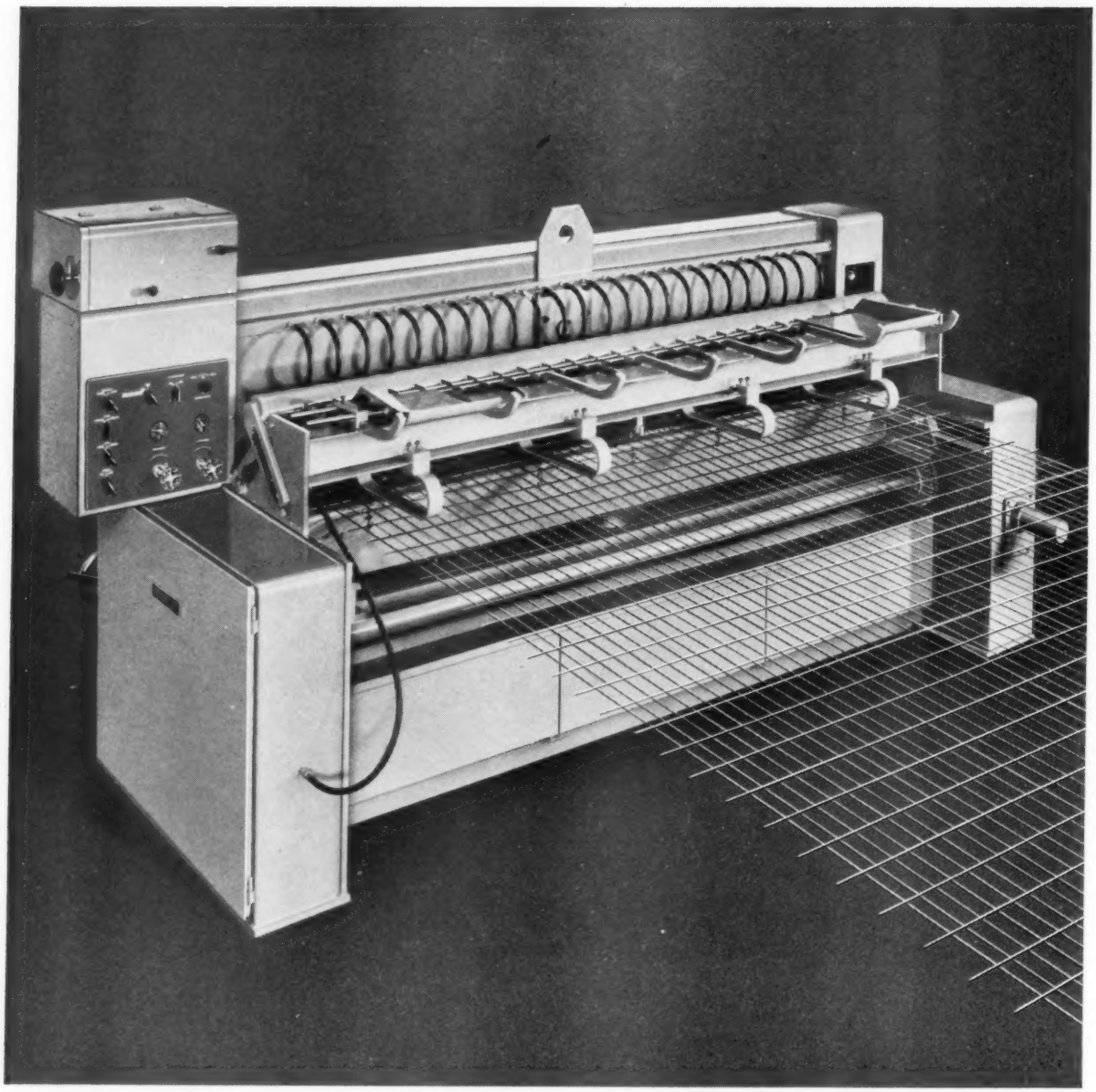
Keystone metallurgists carry on a continuous research for better spring wire so that Western Newell can hold a cost advantage. Such service has made this company a long-time user of Keystone MB Spring Wire.

You, too, can take advantage of Keystone's experience to mass produce your product with wire. For more information, talk with your Keystone Wire Representative. He will be pleased to serve you.

Keystone Steel & Wire Company, Peoria, Illinois

KEYSTONE

WIRE FOR INDUSTRY



For nearly half a century we have been engaged in the development and manufacture of resistance welding machines and it will soon be 15 years since we built our first mesh welder. This many years' experience has proved invaluable in the development of modern mesh welding plants. Today we have a complete range of machines available.

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Size 1 for light mesh in rolls and sheets, wire ϕ 0,06 to 0,16 inch, width 79 inch
Size 2 for concrete reinforcing steel mesh in rolls and sheets, wire ϕ 0,12 to 0,39, width 104 in.
Size 3 for concrete reinforcing steel mesh in rolls and sheets, wire ϕ 0,12 to 0,39, width 147 in.
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Size 5 for heavy concrete reinforcing steel mesh in sheets, wire ϕ 0,16 to 0,47 in., width 104 in.

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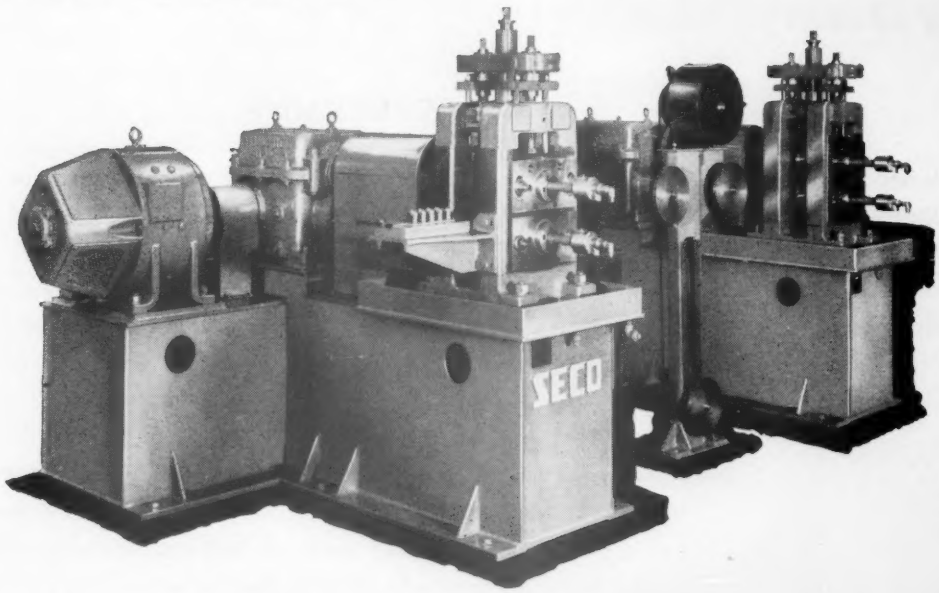
Predictable Performance

is yours when you change to

SECO WIRE FLATTENING MILLS



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Seco's staff of trained engineers . . . specialists in solving production problems . . . are available for personal assistance to you. Call us today.

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- Leveling and Shearing Lines
- Combination Edging and Flattening Lines
- Tension Reels for Strip Polishers
- Narrow Strip Grinding Machines
- Multiple Strand Pull-out Rolls and Take-up Frames
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BUYERS' GUIDE

CLOSING DATE FOR ADVERTISING: FEBRUARY 20

CLOSING DATE FOR PRODUCT LISTINGS: JANUARY 20

1. Send us your changes in product listings, corporate names and addresses promptly. The 1961 Edition of the WIRE AND WIRE PRODUCTS BUYERS' GUIDE now is being edited. Any and all changes should be in our hands before January 20. Your early response will help us to keep the directory up-to-date and *will benefit your business.*

YOUR ADVERTISING

2. It is important, too, to you, your customers and your prospective customers that your listings be REINFORCED WITH ADVERTISING.

The BUYERS' GUIDE is a widely used reference book, used by wire mills, product fabricators, and others in the industry to locate sources of rod, wire, machinery, supplies, etc., when they are in the market to buy. Ad rates are modest.

By providing information on your products, you greatly assist your customers and prospective customers to determine that what you have to sell will fill their needs. It helps to influence sales and in many instances results in direct orders to advertisers.

The WIRE AND WIRE PRODUCTS BUYERS' GUIDE is the only directory in this country published exclusively for the Wire Industry. It is more complete than any other source of supply for this great industry.

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Improved Copper Coating for Wire Increases Coating Adherence, Color Uniformity

AMCHEM CUPRODINE* NO. 5 IS A LOW COST, NON-ELECTROLYTIC COATING FOR LUBRICATING CARBON AND STAINLESS STEEL WIRE, TIRE BEAD WIRE, COLOR CODING AND DECORATING PARTS

The latest Cuprodine from Amchem provides carbon and stainless steel wire and stampings with a particularly effective and adherent copper coating which appreciably reduces scratching of the wire and pickup and wear on dies during forming.

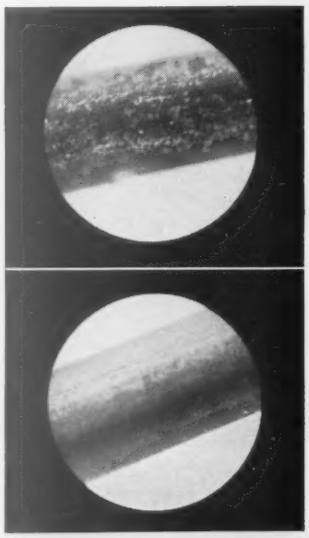
In treating tire bead wire, the uniformity of Cuprodine No. 5 coatings retained during drawing provide an excellent bonding surface for the rubber. Industry has found wide usage for Cuprodines in color coding parts while the durable and attractive copper coating provides an excellent decorative and protective finish on end products.

Investigate Cuprodine No. 5 for your own particular requirement—it's fast, economical, efficient—requires only simple immersion compared to costly racking and auxiliary equipment needed in electroplating processes.

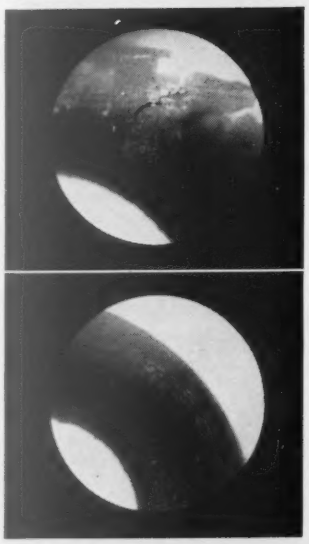
Another development from Amchem's Metal Protection Laboratories, the pioneer in specialized coatings for 46 years—from the first copper coating without the use of electroplating current, to today's standard in copper coating processes—Cuprodine No. 5.

AMCHEM CUPRODINE

Cuprodine is a registered trademark of **AMCHEM PRODUCTS, INC.** (Formerly American Chemical Paint Co.), **AMBLER, PA.** • Detroit, Mich. St. Joseph, Mo. • Niles, Calif. • Windsor, Ont.



At top, photomicrograph (50x mag.) of copper sulfated wire after removal of the coating in ammonium persulfate solution. Note heavy corrosive attack and pitting on copper sulfate-treated wire. At bottom, Cuprodine-treated wire subjected to same test.



At top, photomicrograph (50x mag.) shows copper sulfated wire after simple manual bend test. At bottom, photomicrograph shows bend tested Cuprodine-treated wire exhibiting only a slight attack to coating while copper sulfate-treated wire shows heavy flaking of coating.

*Amchem's registered trademark for its copper coating chemical.

WORKING WONDERS WITH WIRE: at Pittsburgh Steel Company's Monessen (Pa.) Fabric Dept.

Northern Indiana Steel's
rugged, new, operation-proved
WIRE CARRIERS and PAY-OFF REELS

PITTSBURGH STEEL'S $111,000,000 EXPANSION PROGRAM called for a new 125-ton 96-inch wire fabric machine, among many other improvements. To feed this monster, Pittsburgh's Monessen (Pa.) Works makes efficient use of 45 advance-design Northern Indiana Steel Supply Company Wire Carriers and Pay-Off Reels.

SAYS SID JOHNSON, FABRIC DEPT. SUPER:

"Because these wire carriers can safely carry up to 4,000 pounds—depending on the gauge and footage of wire—they help us reduce downtime on this new machine. We now need to weld new reels of wire only every 16 hours, the equivalent of two working turns."

In addition, 500 other Northern Indiana wire carriers have been found ideal by Pittsburgh for *storing* wire. The carriers are easily stacked, leaving maximum use of floor area. Result: good housekeeping with minimum effort.

DESIGNED AND PRODUCED TO YOUR SPECIFICATIONS

Wire Carriers and Reels that

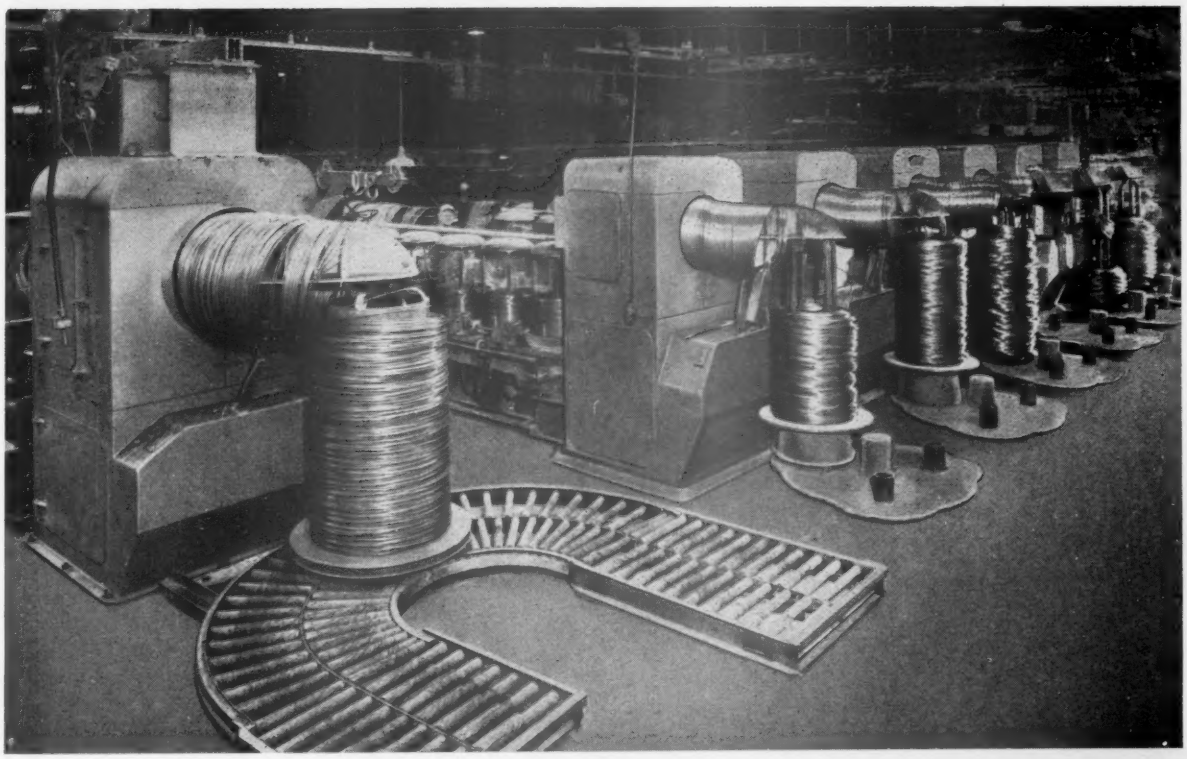
- ✓ **FEED MORE SMOOTHLY**
- ✓ **CARRY UP TO 4,000 LBS.**
- ✓ **STACK AND STORE EASILY**

Let us know exactly what your operating needs require. If we don't already have it in stock, we're ready to make up your order as per your specifications. In any case, we'll be pleased to quote you promptly in quantities specified.

NORTHERN INDIANA STEEL SUPPLY CO., INC.

Fabricating Division, Michigan City, Indiana

TELEPHONE TRiangle 4-3241



A portion of Whitacre Wire Drawing Dead Block installations at Sheffield Division of Armco Steel Corp. at Kansas City

FACTS SPEAK LOUDER THAN CLAIMS!

In actual operation Whitacre Wire Drawing Dead Blocks have delivered . . .

40%

Increase in Production

39%

Decrease in Costs!

Let us prove this statement. Investigate today!

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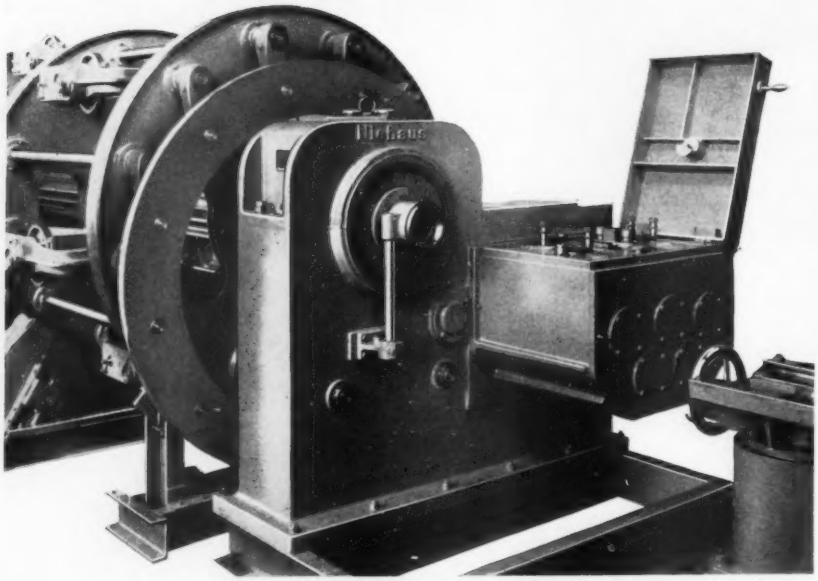
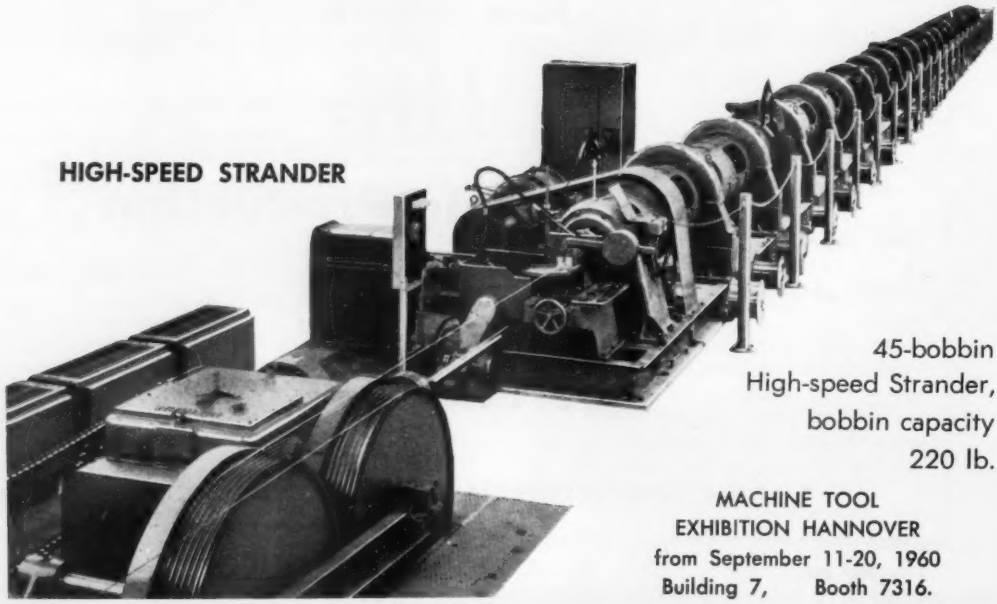
ELECTRIC-CABLE MACHINERY • WIRE-ROPE MACHINERY

PLANETARY STRANDER



We manufacture: Stranding and Rope-closing Machines of tubular and planetary design, of any size and for any number of bobbins, as well as the pertinent auxiliary machinery and equipment.

HIGH-SPEED STRANDER



45-bobbin High-speed Strander, bobbin capacity 220 lb.

MACHINE TOOL
EXHIBITION HANNOVER
from September 11-20, 1960
Building 7, Booth 7316.

MASCHINENFABRIK K. A. NIEHAUS • DUSSELDORF-RATH

Sole Representative: Paul Reicher Machinery & Equipment, Ltd., 600 Eglinton Ave., East, Toronto 12, Ont., Canada

HERE IT IS!

THE FIRST FULLY AUTOMATIC

UNIVERSAL SPRING COILING and LOOPING MACHINE

by **WAFIOS**

Model ZO

TWO MACHINES IN ONE! TWO SIMULTANEOUS OPERATIONS MEAN LESS LABOR AND PRODUCTION COST.

Can Be Pulled Apart and Used Separately.

Here is a truly economical machine with plenty of versatility. Designed for the production of extension springs looped on both ends, this machine can make loops parallel or at any angle to each other.

With the Model ZO, you can produce springs with normal loops, half open loops or machine loops and also, springs having two different types of loops.

The uniformity of placements of loops and lengths of springs far surpasses results achieved by "old fashioned" methods.

Consult us regarding the correct selection of equipment for your spring coiling requirements.

Write for complete catalog and quotations.

THE ZO SERIES OF COILER-LOOPERS ARE AVAILABLE IN TWO MODELS:

	Model ZO/15	Model ZO/30
Wire diameters	.0197" to .0475"	.0394" to .118"
Lengths of Springs	.750" to 5½"	1¾" to 7"
O.D. of Springs	.200" to ⅜"	.394" to 1"

Production on both models up to 40 complete springs per minute.

In addition to the above machines, Wafios manufactures a complete line of spring, coiling machines including: Universal and Segment coilers, torsion coilers, hand loopers, spring grinders, etc.

WAFIOS
MACHINERY CORPORATION
61 HUDSON STREET
HACKENSACK, NEW JERSEY

WAFIOS MASCHINENFABRIK
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HUBBARD TRAVERSES

EASILY ASSEMBLED IN 4 RAPID STEPS TO SAVE COST AND TIME

1 PLACE BOLTS IN REEL HEAD

2 SET HEAD ON FLOOR, BOLTS UP

3 TRAVERSE POSITIONED ON WOODEN HEAD

4 TOP HEAD LAID ON TRAVERSE AND BOLTED DOWN

HUBBARD TRAVERSES are made for nailed wood, plywood, metal bound and cast flanges, constructed of one sheet of metal—rolled, welded and flanged—in painted galvanized or plain finishes . . . easy to assemble and to repair . . . reduces damage to cable . . . increases life of reel due to rigid one piece barrel.

Besides TRAVERSES, every type of REEL and SPOOL—returnable and non-returnable in all materials is made by HUBBARD for shipping and shop use.

WRITE FOR PRICES AND COMPLETE INFORMATION.

HUBBARD SPOOL DIVISION

Van Norman Industries Inc.

TELEPHONE FL 7-5141

GARRETT, INDIANA

The Wire Outlook

Some of the forecasts made earlier for a last quarter pickup appear now to have been over-optimistic.

The country has been going through a readjustment that government officials believe is nearing an end. The start in inventory building in the first quarter, because of the many doubts that developed about the future, dried up and buying reverted to a hand-to-mouth basis. This has cost producers around 11 or 13 billion dollars in sales that they normally might have realized.

In spite of this, the total volume of business, measured in gross material product, has risen. Business is reasonably stable and is expected to remain fairly level, with little additional inflation, depending somewhat on who should happen to occupy the White House next year. Major unions have plans, too, that will add to costs and increase prices, if they are put over next year.

Credit is being eased to spur buying. The general attitude of consumers remains one of confidence, but buying has not been as liberal as last year, as evidenced by a sharp increase in savings, which rose by 105 millions in August. Recently consumer spending has been rising again.

Other plus factors that will bear upon good business is the expectation of a rising volume of construction in the coming year and of government spending, federal, state and local, which is on the upgrade.

Business investment in new plant and equipment will probably be less than in previous years, although it is estimated that more than 4.5 billion dollars will be expended in this direction.

While the automotive industry is readying for an active year, its buying has been slow, due to the carry-over stocks of 1960 cars that must be moved before any real volume in the gleaming new models can be planned for. With a good response to the new cars, this field should become more active in a few months, as a buyer of wire.

The sluggish and down-trend of stock market prices has had a baneful psychological effect, but as has been pointed out many times, stocks in general have been over-priced with respect to corporate earnings. The slump in values bears no basic relation to business conditions. Lower earnings, due to keen competitive selling, has affected the security markets, too.

Not all economists expect business to remain sound, however, some few looking for a further recession. Recessions always are largely a matter of psychology. Fortunately a larger number of economists and business leaders do not see eye-to-eye with the forecasters of gloom.

In the steel wire industry only a moderate increase in business has been experienced, except for welded wire fabrics and fasteners, the sales of which have risen noticeably.

The copper wire mills and electric wire and cable plants appear to be facing new problems. Up to 1958, when 1.6 million pounds of insulated wire were imported, the plants had little to be concerned about from abroad. Now electric wire is coming in at a 14.5 million pound annual rate, which is enough to be felt.

Brass mills still complain of foreign competition. It runs around 200 million pounds per annum. Since price cutting to meet this competition would make it necessary to sell below cost, there appears to be no way out of the dilemma faced by these two industries, unless the government is willing (so far, it isn't) to provide protection.

While there is assuredly some feeling of uncertainty, the majority of responsible observers believe that business will remain on an even keel and that no crisis is building up. This is a time for constructive thinking and action. Postponement of capital goods expenditures that will lower production costs should not be delayed for better times. Whether a machine costs $10,000 or $15,000 is not as important as its effect on production efficiency. Buy now and keep the wheels turning!

Edmund D. Sickels

EDITOR

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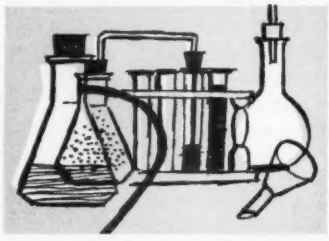

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Vol. 35 NOVEMBER, 1960 No. 11

Setting Incentive Rates in a Steel Wire Mill Under a Union Contract

by Malcolm J. Pollock
Chief Industrial Engineer
Wire Mills
John A. Roebling's Sons Division
The Colorado Fuel & Iron Corporation
Trenton, New Jersey

This paper was presented at the Annual Convention of The Wire Association on November 15, 1960, at Chicago, Illinois.

It certainly is a pleasure for me to be here today to have the opportunity to discuss with you the incentive plan at Roebling. I am a firm believer that more is to be gained by an exchange of ideas between firms in the same business at a gathering such as this than by each firm traveling along its own path working hard to keep secrets from its competitor.

* * *

This paper is largely limited to the Wire Mills Division of our Company. Many things about which I will speak, such as the incentive plan, the Union Contract, etc., are alike or are done similarly throughout the entire Roebling Company; however, since my present scope is limited to Wire Mills Division, I will talk only about this one Division.

* * *

Just to tell you what we are doing now, I strongly feel, would be highly inadequate. If you would have any thoughts whatsoever of duplicating in your plant what we are doing (and we think we have an incentive plan worthy of duplication, at least in part) you certainly should be familiar with what steps were necessary to be where we are today. Therefore, let me take you to the period just before "Pearl Harbor."

* * *

The first Contractural Agreement between the United Steel Workers (then known as the Steel Workers Organizing Committee) was signed on August 25, 1941. This Contract contained a clause, in respect to wages, which read "the same or similar work shall receive the same or similar pay, and inequalities which exist in that regard shall be adjusted under Section 5 of this Agreement." Section 5 referred to, by the way, sets forth the grievance procedure. Following this clause, the Union brought case after case to the attention of the Management, through the grievance procedure, claiming that certain incentives were paying less than some other incentives which they thought were similar. The net result of this clause and its use by the Union was that the average hourly rate paid hourly employees was increasing about 3% annually exclusive of general increases granted.

* * *

Similarly, other difficulties were encountered. Average Hourly Earnings were paid in most cases wherever trouble existed on the job or no rate was available. Paying average hourly earnings for "no rate" made it extremely difficult for the Company to install incentive rates. The employees were receiving incentive earnings for little work; why should they agree to something that was going to mean more work for no more money. In fact, too frequently for the good of the Company, we permitted ourselves to be forced to increase the earning possibility of the rate in order to get it installed. Then, of course, when it came to installing rates for new equipment or new operations, the Company found itself the victim of strong pressures to make the rate yield earnings at least equal to the highest rate paid for some job in the Plant that the Union claimed was similar. On major jobs it frequently took one to two years to get the rate

installed and the employees working at an incentive performance. Meeting after meeting; one excuse after another, just to delay the installation of the rate in order to increase the pressure on the Company to up the yield of the rate. Although there were words in the Union Agreement which granted the Company the right to install rates without mutual agreement, we rarely did so until agreement was reached. This may seem to some of you rather ridiculous; I am, however, quite certain that Roebling was not alone in doing this and would not be alone today if we were still installing rates only after obtaining mutual agreement.

* * *

The entrance into the Second World War by this Country brought with it the wage freeze by the Federal Government's Wage Stabilization Board. A little later on, as some of you may remember, the Basic Steel Companies were directed by National Labor Board on November 25, 1944 to freeze wages, enter into a job classification and incentive program, and set up a fund of 5¢ an hour to correct resultant wage rate inequities. This meant much to our Company. Gradually the Union began to recognize the fact that a logical program was needed. Then in April, 1945 the Directive of the National Labor Board was made a part of our Union Contract. In addition, during this period the Company wrote Job Descriptions for each job in connection with the Job Classification Program, participated with the Cooperative Wage Board which formulated an incentive pattern. Many of you are undoubtedly aware that this Management group developed the Job Classification Program presently in use by many of the Basic Steel Companies and the Incentive Pattern presently in use by several of these same Companies including the Roebling Company.

* * *

At the end of May, 1947, after several months of negotiations and a strike of one month, the Union and the Company entered into an agreement which had incorporated into it, at least in the eyes of the Company, the fundamental clauses required to put into effect the Job Classification Program and a sound Incentive Program. We at the Roebling Company do not take full credit for all of the incentive clauses now in our Contract. Many of them, not all of them of course, were taken from the negotiated Contract between the United Steel Workers of America and the United States Steel Corporation.

* * *

As a result of these negotiations and the Contract which followed, and much hard work on the part of the various managing departments within the Company, the Management of the Roebling Company issued, in writing for the first time, a complete Company-wide Wage Policy. This occurred in August of 1947. Permit me to mention one other thing that was involved in this matter of a Company-wide Wage Policy. Some Management opposition can always be expected to Company-wide uniformity and, believe me, the Roebling Company was no exception. Company men can usually make very persuasive arguments.

* * *

Going into some of the details of the Contract in respect to incentives, I would like to start by telling you of a very important one. The Company now had the right to use the Job Classification Rate (contractually known as the Standard Hourly Wage Rate) as the monetary base of the incentive plan. This may not seem like much, but actually it was very important to us. One item over which the Union and the Company formerly spent hours of argument now could be determined in a meeting with the Union many of which lasted no more than thirty minutes and rarely more than two hours.

* * *

Once the Standard Hourly Wage Rate was established through the Job Classification Procedure there could be no further argument as to what the money should be. The monetary base of the incentive was established. This was a major step forward.

* * *

In addition, one of the later Union Agreements contained a clause which defined "Equitable Incentive Compensation," or the amount the incentive rate should yield over and above the Standard Hourly Wage Rate. It defined it as the extra compensation over and above the base rate or the Standard Hourly Wage Rate in proportion to the actual performance over the work which represents a fair day's work. In simpler language, this meant that our incentive rates should yield varying amounts over the Standard Hourly Wage Rate not only depending upon the employee's performance, but also depending upon the percentage of work involved in the job. This clause did two things for our Company. First, it gave the Company a contractural basis for developing incentive rates which pay varying amounts according to the work involved in the job. This is helpful when adding work to the job; the additional work will mean an increase in earnings. In the case of wire drawing, an employee drawing a large diameter wire where he has almost no stand-by or idle time, will earn more money for the same performance than another employee who is drawing a small diameter wire and has considerable stand-by time waiting for the machine to finish drawing the coils. The second benefit of this clause is the fact that it determined how much more money the more work should pay instead of depending upon the outcome of some negotiations on each individual case to tell us how much the additional work was worth. Under the former plan our employees have always demanded a greater increase in earnings than what the increased work warranted.

* * *

In December of 1947, prior to the installation of the Job Classification Program, our Company presented to the Union the first plan based upon the new incentive concepts, using the Company's proposal what the Standard Hourly Wage Rate should be, and offering to pay retroactivity should the Standard Hourly Wage Rate be later increased. As you might expect, the employee reaction was quite violent. It so happened, in this case, that the yield of the incentive was less than that of the employees' former job, the jobs the Union maintained were similar. The Company took the position that the new automatic method was a series of new jobs largely utilizing new equipment and should

not be related to the employees' former jobs. Immediately in accordance with the terms of our Union Agreement the case was taken to an Arbitrator.

* * *

Although the Arbitrator upheld the Union's grievance, and required the Company to revise the incentive plan to use the Average Hourly Earnings of the former jobs, his decision was based on our having "jumped the gun." The Arbitrator stated in his opinion that the Management of the Company had the words in the Contract to support their new incentive pattern only after the Job Classification Program was installed, and not before. Although this appeared at the time to be quite a blow to our hopes of a more practical incentive pattern for our Company, it later proved to be the contrary. In August, 1948 the entire Job Classification Program was completed and made effective; then in September of that year we installed another incentive plan using the new incentive concepts. Again both parties went to Arbitration. This time the Arbitrator supported the Company's contention.

* * *

The new concepts included, in addition to the use of the Standard Hourly Wage Rate as the monetary base of the incentive plan, the installation of the incentive plan after adequate explanation of the plan to the Union and the Employees on the job instead of first trying to obtain Union acceptance of the plan. This does not mean that, in our explanation of the incentive plan to the Union, we do not try to show the Union that this is a good plan. We do, very much so. What it does mean is that we install the plan and stand behind it unless the Union or the Employees on the job can prove some error has been made. Let me quickly add, you can be sure we make certain beforehand this will rarely occur. The Union does, however, in most cases process a grievance after a 30-day trial period required by our Contract.

* * *

When we first talked to the Union and our employees of such a program, you probably can well imagine what happened. The employees were trained over the years that by lying down on the job they would force the Company to increase its offer. Then suddenly, the Company had a new plan and would not change the rates from what was originally offered unless the Union or the employees on the job could prove an error was made in the development of the incentive rates. Slow-downs followed and our Industrial Relations Policy was subjected to severe criticism. Fortunately, we did not have to discharge a single employee. When the employees, who were lying down on the job, would finally realize that the Company was not going to change the rate and they were going to be discharged, they would go to work. As a result, they would earn incentive and the rates would prove themselves.

* * *

Now about the plan itself, what do we pay for what? How does it work? Let us go into a discussion of these items. First of all, this new incentive plan at the Roebling Company is a "one for one" direct incentive plan with the rates expressed in standard hours per 100 pounds, per 1000 pounds, per coil or whatever the unit may be. None of the new plans are indirect where the earnings are calculated on production produced by someone else, nor are any of the new plans of a bonus nature where the employee is paid a tonnage rate plus an hourly rate. Under the old system we had incentive plans of almost any type you could conceive. Our present Industrial Engineering Group is of the opinion that the indirect plans too often do not operate as incentives; instead merely become "gifts," and the bonus plan has so little "incentive pull" you are better off with none.

* * *

When we obtain a new piece of equipment it is rarely similar to our existing equipment. If an identical piece of equipment is purchased, the existing incentive plan is transferred as is to the new equipment. However, since rarely this is the case, most jobs are time studied. This is done by several Time Study Engineers. All their data is analyzed and compared with data previously gathered to determine if there is on file a time value for the element of work. If so, the previous time value is used unless there is a very good reason for not doing so. If no time value has previously been determined then the new time value is used. Considerable work is done to be certain that the value is correct and compares logically with other time values of somewhat similar work. All this represents considerable Industrial Engineer work, and may seem expensive. It does not have to be expensive if it is objectively pursued, and saves considerable time in arguments later.

* * *

In this fashion the time value for each element of work is determined. To these times, allowances for personal and rest ranging from 5% to 20% are added. The amount of the allowance is determined from a table which was developed by the same Cooperative Wage Bureau that developed the entire incentive plan.

* * *

Once we have determined the work the employees have on the job, and have converted the time into time per unit whatever the unit may be in the particular case involved, we can readily calculate the stand-by time by a subtraction of the work time from the time to produce the unit. The stand-by time is the time the employee is standing-by waiting for the machine to complete its cycle. To this stand-by time we add a 5% incentive extra. The work times already have a 35% incentive extra performance rated into them when the time studies are taken. By this we mean that our Time Study Engineers have performance rated into the time an amount to make it possible for our average employee working at a good incentive pace to earn 35% extra while doing this work. Thus our incentive plans pay the employee varying amounts from 5% to 35% over the Standard Hourly Wage Rate depending upon the amount of work in the job.

* * *

As I have stated previously the rates of our incentive plan are expressed in Standard Hours. In this way, we do not have to retype all the rate sheets each time a general increase is granted. Since the Standard Hour figure is usually a

four number decimal figure and thus difficult for the employees to comprehend, we give them the number of pounds per hour required to earn the Standard Hourly Wage Rate or make a 100 Index as we call it; in addition, when an incentive plan is first presented to a group of employees they are given the rates expressed in dollars which will hold true until the next general raise. Furthermore, we have had this plan in operation for sufficient time now that most of our employees have learned to calculate the rate in dollars by merely multiplying the standard hour figure by the Standard Hourly Wage Rate.

* * *

Once the incentive rates are computed and thoroughly checked, we in the Wire Mills Division of our Company have a manual typed. This manual is a booklet that includes all the data used to compute the incentive rates starting with the work elements on through the formula computations and ending with a copy of the rate sheets. Additional rates, and about 20 of these rates are issued from our office weekly, are computed in much less time than would be possible without this formalized record.

* * *

The completed manual is then forwarded to our Central Industrial Engineering Office who review the plan to make certain that the principles used comply with our Company-wide Incentive Policy. Having received approval of the plan it is then presented to the Union and the employees on the job. If after this is done and a short time passes, it appears that the employees are not going to give the new plan a fair trial by working at an incentive pace then the Company moves in, utilizing the combined efforts of the Production and Industrial Engineering Departments. This cooperative effort between the two Departments has done much to bring about a situation where the employees work at an incentive pace. We have in our Wire Mills a team of three men known as Assistant Superintendents, one on each of the three shifts, whose job is trouble shooting as well as acting Superintendents on the night shifts. One of these Assistant Superintendents and one Industrial Engineer, if required on all three shifts, live with the job answering any questions that may arise and keeping the pressure on the employees to make certain they perform the job in the same manner upon which the rate was developed. It is our experience that this continued observation and the presence of the two Company Representatives day after day puts sufficient pressure on the employee that he goes to work. Once he goes to work, he begins to make incentive earnings and the incentive plan proves itself.

* * *

The new incentive concepts at the Roebling Company have some additional methods of payment that I should bring to your attention. For "no rate" we pay the Standard Hourly Wage Rate. For delays not included in the rate, such as mechanical, electrical or waiting for material, the Standard Hourly Wage Rate is paid; similarly, the minimum guarantee is the Standard Hourly Wage Rate. Also the quality requirements of the job are built into the incentive plan by omitting from the production counted for incentive payment any faulty production which, in the opinion of the Foreman, was caused by poor workmanship on the part of the employee on the job. This feature of the plan has been quite helpful in maintaining the high quality standards of our Company.

* * *

Of course, we still have a number of plans in effect which were established prior to 1948 when the new concepts were put into effect. In administering these plans we merely continue to follow the original pattern established. If, however, a major change occurs, in accordance with our Agreement, the plan is cancelled and a new plan is developed based upon the new conditions. This is all very good as I say it to you, but suppose the new plan does not pay as much as the former one. What do we do then?

* * *

Here is where I must tell you of some less desirable features of our incentive pattern at the Roebling Company, at least undesirable from the Company point of view. Our agreement with the Union requires it. I suppose every negotiated contract that has some desirable clauses from the Company standpoint, must also contain some undesirable ones. We have in our Union Agreement provisions which require the Company to develop and pay an Out-Of-Line Incentive Differential when a new incentive plan replaces a cancelled one and the new one does not yield earnings equal to the former one for the same work. This Out-Of-Line Incentive Differential is an hourly rate paid to everyone on the job for all hours, in addition to the earnings from the incentive plan, and is the amount necessary to bring the new plan earnings up to former earnings taking into consideration any increase or decrease in work.

* * *

On new units of equipment or improvements on our present equipment, it is frequently necessary to develop maximum operating speeds before the incentive rate can be established. This determination of maximum speed is done by our Metallurgical Engineering Department. Where the limitation is the ability of the equipment, then of course, the Plant Engineering Department personnel is utilized. However, where the limitation is the quality of our product, the Metallurgical Engineering Department alone recommends the maximum speed. This may give you the thought that having the Metallurgical Engineering Department, which in many companies as well as in ours determines the quality standards, would result in lower than desirable speeds from the cost point of view. Our Metallurgical Engineering Department considers quality to be sure; however, they also consider that we must stay competitive; hence generally speaking, we operate our equipment at the most economical operating speed which conforms with the quality standards required by the Roebling name.

* * *

Three other considerations are made before the incentive plan is completed. In fact, the first two of these items are considered before the time studies are completed and the third item is considered both

(*Please turn to page* 1592)

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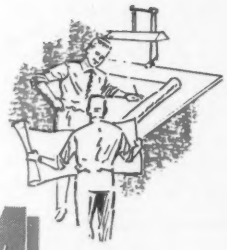

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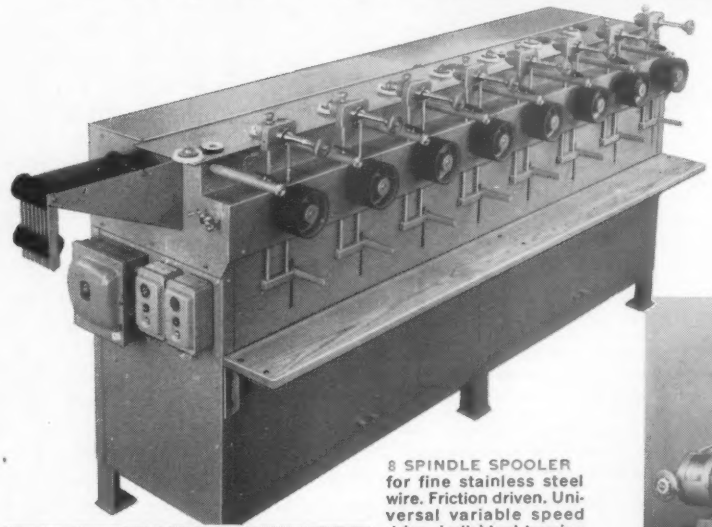

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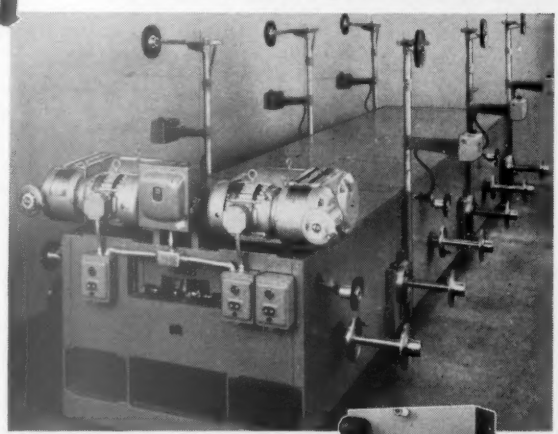
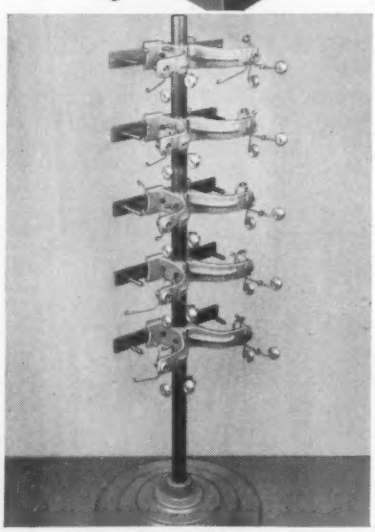
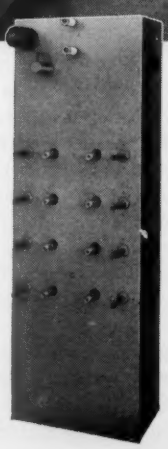




6 HEAD RESPOOLING MACHINE. Three heads on each side of machine. Handles reels ranging from 12" to 24" head diameter and traverse up to 12".

10 HEAD SPINNER-TYPE LET-OFF. Automatic brake tension control. Ceramic guides. Spool is stationary, does not rotate. Machine requires small floor space area.



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Controlling Copper Rod & Wire Mill Scrap and Losses

by John A. Bell
Development Engineer
Western Electric Company
Chicago, Illinois

John A. Bell

This paper was presented at the Annual Convention of The Wire Association on November 16, 1960, at Chicago, Illinois. Mr. Bell graduated 1943 from the University of Illinois with a B.S. degree in Metallurgical Engineering and an A.B. degree in Chemistry, and joined Western Electric Company upon graduation. He has held various assignments at the Hawthorne Works, including casting, rolling, heat treating, metallurgy and raw materials engineering. Currently he is a Development Engineer in the Copper Rod and Wire Mill. He is a member of the Wire Association and the American Society for Metals, as well as a number of engineering honorary societies.

An important part of the Western Electric Comany's job as the manufacturing and supply unit of the Bell System is to manufacture communications cable. The cable is manufactured in plants at Chicago, Illinois; Kearny, New Jersey; Baltimore, Maryland; Omaha, Nebraska and Buffalo, New York. In Chicago, the Hawthorne Works operates a copper rod hot rolling mill which produces an appreciable part of the Company's redraw rod to be used in cable. Figure 1 shows a diagram of the rod mill layout.

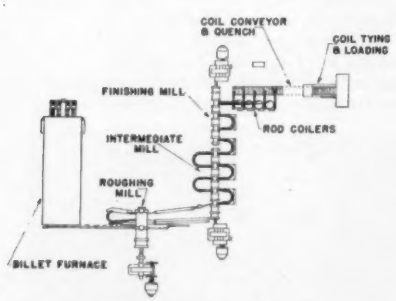

Fig. 1. — Diagram of Rod Mill Layout. * *

Because of the large volume of material processed in the rod and wire mill operation, even though each scrap item is only a fraction of a per cent of total material used, scrap losses must be very carefully controlled. There are two major reasons which make a close control mandatory. One obvious reason is the economical aspect. In a rod and wire mill operation, as in cable manufacture in general, the material cost in the product is the major part of the final cost of making the product. Accordingly the greatest potential in savings is in material costs and consequently in reducing scrap and losses. For example, if a rod mill produced many thousands of tons of rod in a year, an unaccountable loss of only 0.1 of 1% of the copper used could be an unaccountable loss of many tons, even up to railroad carload quantities. With copper costing thirty cents a pound, this could justify a great deal of study and corrective action. If the saving is realized, it could be equivalent to eliminating the need for a number of men in the mill. A second important reason for controlling copper losses is due to the possibility of copper polluting the Hawthorne Plant effluent. Copper is one of the metals which, when it is in solution, retards biological treatment processes for sewage (2). Accordingly, we must carefully control our wastes from the copper rod and wire mill for this reason as well as the economic reasons.

* * *

A description of the Hawthorne rod and wire mill will provide a better understanding of scrap and losses that occur during the mill operations. Electrolytic tough pitch copper wire bars weighing 250 pounds each are used. Their size and shape are standard A.S.T.M. 4″ x 4″ x 54″, and they are purchased from a number of suppliers. The wire bars are loaded onto the charging table of the bars heating furnace. Two rows of 110 each or 220 bars are pushed through the oil fired furnace, taking 1¼ hours for the heating cycle. Once loaded on the charging table, a bar is controlled automatically until the rod exits from the 11th pass of the mill. When a bar is discharged from the heating furnace, a conveyor at the discharge end of the furnace places the bar under a radiation pyrometer where the temperature is recorded. If it is too cold, the bar is automatically discharged to a reject rack. If the temperature is satisfactory, the bar is fed to the roughing mill where it is given five reductions in cross-section. See Figure 2. The roughing mill is a 3 Hi 20″ mill operating at 123 rpm with an 800 horsepower AC drive motor. The copper bar exiting from the 5th pass of the roughing mill runs through a trough to the intermediate mill.

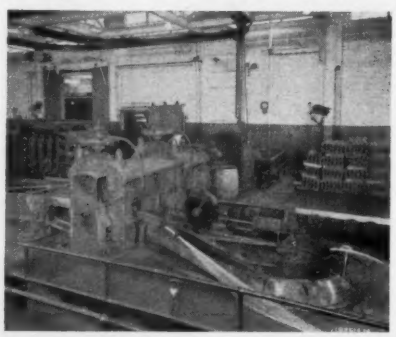

Fig. 2 — Roughing Mill. * * * * * *

The intermediate mill and the

finishing mill (See Figure 3) are Belgian cross-country looping mills which produce five and four reductions respectively, making a total of 14 reductions from 4″ x 4″ billet to 0.275″ rod. Both intermediate and finishing mills have approximately 12″ to 14″ roll diameters, operating at 277 and 411 rpm respectively. They are powered by

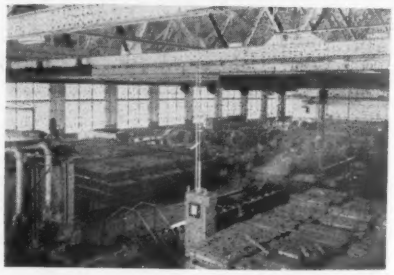

Fig. 3 — Overall View of Rod Mill. * * *

900 and 800 horsepower AC motors respectively. When a copper bar passes through the trough from the roughing to the intermediate mill, a photoelectric cell over the trough causes the release of the next wire bar which is waiting under the radiation pyrometer. As this bar enters the roughing mill, it actuates a photoelectric cell which causes another bar to be pushed from the bar heating furnace and positioned under the radiation pyrometer. As shown in Figure 3, men still manually catch the rod coming out of the 11th and 13th passes and stick it in the 12th and 14th passes. The rod exits from the 14th pass at 1500 fpm and is coiled. The coiled rod is quenched, tied with wire, and pickled to remove the copper oxide scale. After a water wash and a hot soap dip, the rod coils are either delivered directly to the wire drawing machines or loaded into box-cars for shipment to other Western Electric wire mills.

* * *

In the wire mill, the underfilled ends of the rod coils are cropped by the operators of the rod breakdown machines, and the coils are butt-welded together to provide a continuous supply for these machines. The rod is drawn into 14 gauge supply wire which is used at the intermediate machines for drawing into 19, 22, 24 and 26 gauge wire. These are the four gauge sizes used in the Hawthorne cable plant. Wire on spools at final gauge size is annealed in controlled atmosphere furnaces, inspected and trucked to the insulating machines in the Cable Plant.

* * *

As you have seen, there are a number of sources of recovered or non-recovered copper scrap in a rod and wire mill operation. One major source of recovered scrap is the copper oxide scale which is flaked off and flushed away by the roll cooling water as the rolls reduce the copper rod cross-section. This cooling water falls from the rolls into a sluiceway under the mill stands. From here the water flows to a large settling basin outside the building where the scale settles out as the water flows around a number of weirs. Then the clarified water is pumped back to the mill and re-used for roll cooling and flushing. The scale that accumulates in the settling basin is cleaned out a number of times a year, at which time the scale is piled in a two compartment concrete bin for drying. The coarse, black oxide which accumulates at the entrance side of the basin is piled in one bin, and the red "mud" which settles farther out in the basin is stored in another bin. The coarse, black oxide commands a better market price. Scale in the air at the mill stands is collected by drawing air through the stands and washing the air with water sprays to remove the oxide. The total mill scale quantity collected from all sources in the rod mill, including oxide collected on the floor at the conveyors and repeaters, totals hundreds of thousands of pounds a year.

* * *

At this point in the rod mill operation, an important step can be taken to reduce the amount of scrap. That step is to determine the optimum wire bar temperature going into the mill. If the bar is too cold, the bar may not repeat satisfactorily, but on the other hand, the higher the billet temperature, the greater the amount of oxide scale created. A comprehensive paper (1) on the relationship of copper oxide formation and temperature by **Dr. R. F. Tylecote** in the **Journal of the Institute of Metals** reveals the magnitude of the temperature effect. As Dr. Tylecote points out, above 970°F. the oxidation of copper in dry air is parabolic in accordance with the equation $w^n = K_1 t + B$. He states the index n varies from 2.0 to 2.2; w is the weight gain (mg./cm²); K is the oxidation rate constant; t is the time (hours) and B is a constant (probably zero when n=2). The oxidation rate constant K is dependent on the absolute temperature of the copper as shown in the equation $K = Ae^{-Q/RT}$ where A is a constant; T is the absolute temperature (°K); Q is the activation energy (cal/mole), and R is the gas constant. For high temperature oxidation, Q is about 40,000 cal., and A for annealed copper in dry air is 79.5. It is to be noted that Dr. Tylecote's equation is an adaptation of Arrhenius' equation for rate measurements of different chemical reactions at various temperatures. This work indicates that when the rolling temperature of copper bars is raised 100°F., the resultant amount of oxide scale can be expected to be 50% higher. The corresponding economic loss per pound of copper in scale is the difference between the value of good rod and the value of copper in the form of oxide scale.

* * *

In addition to the scale from hot rolling, there also of course is rolling scrap due to failures to repeat, knots in the tail end of the rod, and equipment failures on the mill. This scrap, which is balled or sheared, is less than ½ of 1% of the copper rolled; however, it is of sufficient quantity to be an important raw material for Hawthorne's brass mill and for Western Electric's subsidiary, Nassau Smelting and Refining Company.

* * *

Another major source of recovered rod mill scrap is in the pickling operation where the copper oxide is removed by sulphuric acid, forming copper sulphate. To counteract the continual build-up of copper content and the depletion of free sulphuric acid in the pickling solution, it is continuously recirculated between the pickling tanks and electrolytic recovery tanks where the copper is plated out and recovered as cathodes. See Figure 4. The operation regenerates sulphuric acid so the only

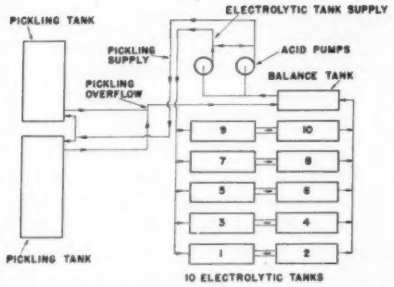

Fig. 4 — Diagram of Pickling Solution Electrolytic Recovery System.

acid and water additions made to the tanks, barring leaks, are to replace solution carried out to the wash tanks on the copper rod coils. The solution never should need to be thrown away. Copper sheets .020" thick which are discarded by the Hawthorne Works phenol fibre manufacturing operation serve as starting sheets for cathodes in the plating tanks. Lead sheets ¼" thick serve as anodes. A 96 kilowatt germanium rectifier furnishes low voltage DC current up to 4,000 amps. Using the electrolytic recovery system to make cathodes, we expect to recover from the pickling solution about 0.2% of the copper rolled. This type of recovery system for copper pickling solution is very similar to an electrowinning system commonly used by large copper refineries.

* * *

In the wire mill, solid rod and wire scrap is generated at the wire drawing machines. As previously mentioned, the ends of the rolled rod are cropped at the rod breakdown machines. Also a certain amount of drawn scrap is made at the wire drawing machines and the annealing furnaces. This scrap is balled and used in the Company's brass mill operation.

* * *

A fractional per cent of the copper rod goes into the drawing compound as copper dust created by the friction of the capstans and dies. As a point of information, the drawing compound is water base with beef tallow, rape seed oil and soap as the other ingredients. The lubricant is compounded and colloided by the wire mill personnel and supplied from two central systems. One supplies the rod breakdown machines, and the other supplies the machines that draw the wire to the final gauge sizes used in communications cable. Copper dust in the lubricant continuously settles in the large central storage tanks used for the compound, and about once a month the liquid is siphoned out of the tanks, and the copper dust in the form of sludge is placed in barrels. The sludge has around 30% copper content, the balance being water and fat from the compound. Only 0.1% of the copper drawn at each machine is deposited as sludge in the compound tanks, but this still generates a number of railroad carloads of sludge each year.

* * *

Regarding non-recovered scrap, there are several places where copper is lost in the rod and wire mill operation. Investigation has shown that recovery of these particular losses is not economical. In the reverberatory oil fired billet furnace, some copper oxide goes up the furnace stack. Preliminary flue gas analysis has indicated that the quantity is not significant. At the settling basin for the roll cooling water, overflow takes place and carries out copper oxide. Also at the hot mill rod quench, copper oxide goes to the sewer. This water is supplied from the settling basin. At the wash tanks for pickled rod, copper sulphate, copper oxide and copper particles are lost in the overflow. Leaking pickling solution facilities however can be a very significant cause of copper loss. In the wire mill apparently the only non-recovered scrap is copper dust deposited outside the wire drawing machines.

* * *

The human element enters into the copper loss picture again and again. For example, if many hundreds of tons of copper oxide scale from the rolling mill and copper bearing sludge from wire drawing compound are sold each year, the dollar recovery for the scrap is very dependent on the accuracy of each assay of the scale or sludge. To assure accuracy when the scale or sludge is received by a purchaser, the material is sampled by both the purchaser and a representative of an independent laboratory engaged by Western Electric. The analysis of both must agree by 1% or else a third referee laboratory is used.

A number of policing methods can be used effectively to control copper scrap and losses. One method is to make an accounting analysis of copper usage after each annual inventory. The beginning of the year inventory of rod, wire, scrap and copper wire bar in transit plus copper purchases during the year is the total available copper for the period. This should be exactly equal to the amount of good rod and wire shipped, plus the scrap shipped, plus the ending inventory, including bars in transit, plus known non-recovered losses. Any difference between these two sums is a material variation which should be explainable. If the variation is not explainable, there may be some real cost reduction potential in the situation. This same accounting analysis can also reveal scrap items which are out of control so that the proper action can be taken to bring them under control again. An example might be cropping excessive lengths of rod ends at the rod breakdown wire drawing machines. The quality of uncropped rod ends varies from coil to coil. Accordingly a wire drawing operator can minimize this scrap by using good judgment on what length of cropping he makes. Unfortunately, when not policed, an operator commonly feels that if a certain length of cropping is satisfactory, an even longer length will be better. However increasing the average cropping length per rod coil by two feet would result in an annual Hawthorne loss of many thousands of dollars, based on the value of good rod minus the value of scrap. If monthly as well as annual scrap reports are made, out of control scrap items are revealed even more quickly. For example, Hawthorne's electrolytic copper recovery system should produce a certain number of cathodes a month, depending on the production program. Significant variations from this amount of delivered cathode scrap might indicate an out of control condition in the electrolytic recovery system.

* * *

The pickling solution used to remove the oxide scale from the rod is controlled to 3% maximum and 1% minimum copper content by weight. Free sulphuric acid content is controlled between 5 and 9%.

Reports of pickling solution analyses are routed to the engineer as well as the operating supervisor, and continual vigilance must be used to keep the solution analysis within limits. If the copper content gets too high, not only is the pickling operation prolonged and the capacity of the system reduced, but also excessive amounts of copper are carried out to the wash water and from there to the sewer. If on the other hand the copper content becomes too low, the resultant cathode deposit is loose, not solid; the efficiency of the operation is reduced, and scrap recovery is adversely affected.

* * *

An additional investigative procedure has been introduced at the Hawthorne Works in order to monitor the plant effluent; the Hawthorne plant engineers have had a continuous effluent sampler and proportional flow meter designed and constructed. See Figure 5. It

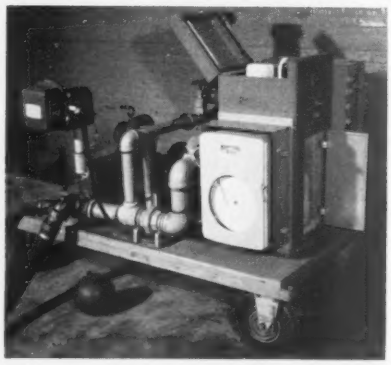

Fig. 5 — Continuous Flow Meter and Proportional Sampler. * * * * * * * * *

is used in conjunction with a V-notch weir installed in a manhole between the plant and the sewer. With these facilities the rate of flow of liquid can be recorded continuously and cumulatively. Also the effluent can be continuously sampled proportionately to the rate of flow, so a representative sample is obtained. This equipment uses a float device behind the weir to measure and record the rate of flow and cumulative flow. A pump continuously supplies the proportional sampler by removing liquid through a sampling line behind the weir. The liquid then is returned behind the weir so that rate of flow measurements are not erroneous.

* * *

With this combination sampler and flow meter, Hawthorne is able to monitor not only for waste materials in general but specifically for our non-recovered copper losses from our rod and wire mill. This can be done over an appreciable length of time with little labor involved. These losses, we have found, though they are not recovered, do explain some variation in the annual copper usage analysis. Also this monitoring information provides a basis for deciding whether or not the loss economically justifies recovery. We have found that overflow water from our rod wash tanks following the pickling operation carries out a certain quantity of copper a year. However to recover this would require facilities, labor and materials. Such facilities might utilize the cementation process of iron replacing copper in solution; for example, a launder, a tank or a tower filled with scrap steel or sponge iron would collect the copper as a finely divided loosely adherent deposit. Another type of facility which might be used would be to install demineralization equipment which would recover the copper in a cation exchanger and also recover the water as deionized water; however, this equipment would require new rod wash tanks in countercurrent series to concentrate the copper in the rinse water and reduce the volume of water to be treated (3). The installation and operating costs for facilities which would be required to treat the total amount of Hawthorne wash water overflow currently make the proposition uneconomical.

* * *

Likewise we have found that the overflow water from the rod quench and from the roll cooling water settling basin contains a relatively small amount of only solid copper oxide and iron oxide. Again the recovery is not economically justified. For example, by increasing the pH of the settling basin water, as **Mr. G. W. Pirk** of Rome Cable Corporation has pointed out (4), some of the copper oxide would be precipitated out to reduce the amount lost in the overflow; however, the cost of controlling the pH with sodium hydroxide additions in our case does not appear economically justified.

* * *

In summary the following procedures are important to the control of copper rod and wire mill scrap and losses.

1. **Control wire bar temperatures to minimize oxide formation consistent with good mill practice.**
2. **When removing mill scale from the settling basin, divide the black and red oxide and sell them separately.**
3. **Maintain and operate the electrolytic recovery system for pickling solution within specified limits to get maximum copper recovery from the pickling solution.**
4. **Minimize rod cropping at the wire drawing machines, consistent with good wire drawing performance.**
5. **Carefully control the calibration of weighing facilities, tare weights and assaying of scrap.**
6. **Have annual accounting analyses made of copper usage to reveal significant variations.**
7. **Have monthly scrap reports made in conjunction with production reports to quickly reveal out-of-control scrap items.**
8. **Periodically monitor for copper content the effluent from rod and wire mill operations.**

* * *

Following these steps to minimize scrap and losses can significantly reduce costs in the manufacture of copper rod and wire.

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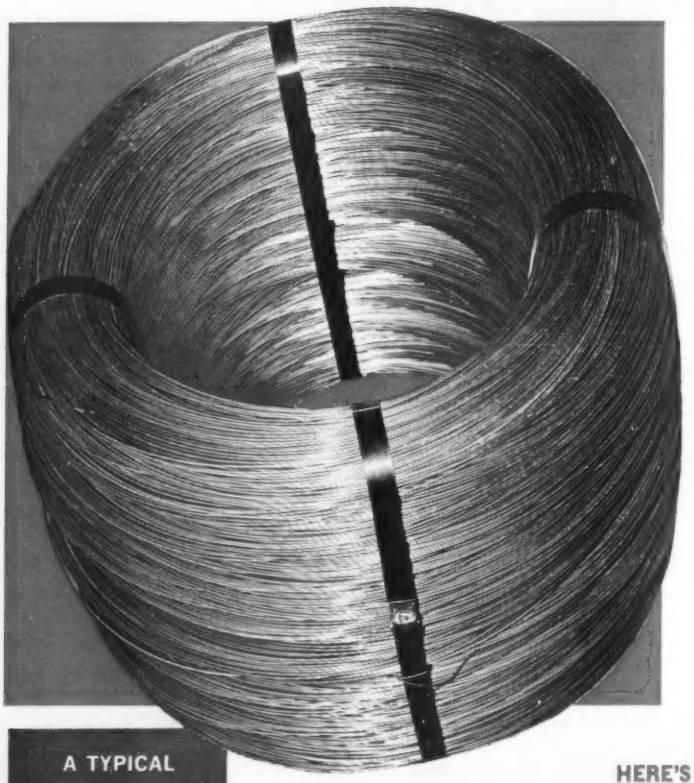

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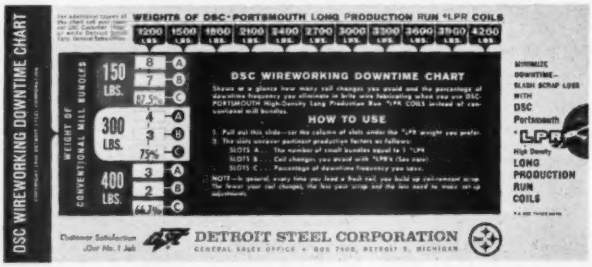

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Effects of Environmental and other Conditions on Dissipation Factor and Dielectric Constant of Very Low-Loss Polyethylene Compounds

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Abstract

The electrical properties of very low-loss electrical grade polyethylenes are sensitive to certain environmental factors. The manner of sample preparation and many other variables affect the dissipation factor and dielectric constant significantly. The thermal history and moisture conditioning of the test specimens are particularly important.

* * *

In the past these effects have been to a large extent overlooked because electrical measurement techniques were inadequate. With the development of improved sensitivity in electrical testing methods, including the adoption of the liquid displacement ("benzene cell") procedure now published as ASTM Method D 1531, it is possible to detect differences in electrical properties that previously were thought not to exist. The effects described are very significant and their existence must be recognized for proper evaluation of materials.

Thomas Hazen

This paper was presented at the Annual Convention of The Wire Association on November 15, 1960, at Chicago, Illinons. **Mr. Hazen graduated from Muskingum College in 1926 with a degree of AB in Physics. After three years as a Graduate Assistant in the Physics Department of the University of Pittsburgh, he joined the Technical Staff of the Physics Laboratory in the Bakelite Corporation's Development Laboratory in Bloomfield, N. J. Here he worked on electrical, mechanical and thermal evaluation of plastics. Later, specializing in dielectric measurements, he was transferred to Bound Brook. He is a member of a number of technical societies and has served on two ASTM committees having to do with electrical insulation.**

I. Introduction

The dielectric constant of primary insulation is a fundamental material property of great importance to the manufacturers of insulated wire and cable, particularly those for use in radio and telephone communication equipment. In a coaxial cable, for instance, such characteristics as capacitance per foot, velocity of propagation, and characteristic impedance are dependent upon the dielectric constant of the primary insulation. Uniformity of these characteristics throughout long lengths of cable contributes to efficient operation by keeping reflections and standing waves to a minimum. The dielectric constant measurement is therefore of critical importance for specification purposes and for batch-to-batch control of uniformity of a product during manufacture.

* * *

The dissipation factor of primary insulation is significant as an indication of the power loss in the insulation when it is subjected to an a-c electric field. In a coaxial cable the dissipation factor of the primary insulation governs the contribution of the dielectric loss, which when added to the conductor losses, determines the total attenuation in a length of cable. For maximum efficiency and predictability of performance of a cable it is therefore necessary that the dissipation factor of the primary insulation be not only very low but also as uniform as possible throughout long lengths of the cable. Being particularly sensitive to the presence of contaminants, oxidation products, moisture, etc., the dissipation factor is of the utmost importance for specification and batch-to-batch quality control test purposes.

* * *

Commercially available polyethylenes have dielectric constants in the range from about 2.26 to 2.36, corresponding to a density range of 0.91 to 0.96 gms/cm^3, approximately. This paper is concerned mainly with so-called "low-density" polyethylenes (Type 1, Class A, of ASTM Specification D 1248-59T) produced by the high-pressure process and having densities close to 0.92 gms/cm^3.

* * *

Specifications for electrical grade polyethylenes usually require that the dissipation factor shall not exceed 0.0005. Superior grades of polyethylene for electrical purposes generally have dissipation factors substantially better (lower) than this. For the purposes of this paper, "very low-loss" will be used to characterize polyethylenes having dissipation factors less than about 0.0002.

II. Recent Improvements in Electrical Testing Methods for Polyethylene

1. The BTL "Benzene Cell" Technique for Dielectric Measurements on Polyethylene

About four years ago, Bell Telephone Laboratories and Western Electric Company promoted the use of the benzene-displacement ("benzene cell") technique for the measurement of dielectric constant and dissipation factor of polyethylene compounds for use as primary insulation in submarine telephone cables, and introduced a material specification requiring that polyethylene for this application have a dielectric constant of 2.280 ± 0.006 and a dissipation factor of less than 0.0005. Acceptance and control tests at 100KC and 1MC were specified.

* * *

The benzene-displacement technique, which is now published as ASTM Method D 1531[1], provides for the determination of the dielectric constant of polyethylene by direct comparison with the dielectric constant of chemically pure benzene in a special test cell originally designed at Bell Telephone Laboratories. When 50-mil plaques of polyethylene are inserted between the fixed parallel plate electrodes, spaced 60 mils apart, of the test cell containing benzene, some of the benzene is displaced and the capacitance of the cell may be changed by a small amount, $\triangle C$. From this small capacitance change, the cell dimensions, the thickness of test specimens, and the precisely known dielectric constant of the benzene at the test temperature, the dielectric constant of the polyethylene is calculated. The dissipation factor of the polyethylene is computed from measurements of the cell with benzene alone and with the test specimens immersed in it. A considerable simplification of the ASTM D 1531 computation of dissipation factor results if the benzene is assumed to have a dissipation factor of zero, which has been found by special test to be practically true, since careful measurements on representative samples of benzene in our laboratory have shown a dissipation factor at 1MC of not more than about 0.000002. The precision (reproducibility) of the dielectric constant determination for polyethylene compounds having dielectric constants nearly the same as that of benzene has been demonstrated to be about ± 0.05% for within-laboratory tests and about ± 0.10% for interlaboratory tests. Dissipation factor accuracy and precision depend upon the sensitivity of the testing equipment. No special difficulty is encountered to determine, with commonly available apparatus, that the dissipation factor is less than 0.0005 at 100KC or 1MC.

* * *

In addition to the high precision of dielectric constant determinations, the benzene-displacement method has the advantages of not requiring extremely accurate thickness measurements of, or application of electrodes directly to, the test specimens. The large area of the specimens (18 sq. in.) contributes to the accuracy with which the dissipation factor can be measured.

* * *

Very recently the proposal to tighten the dissipation factor specification for polyethylene for primary insulation of some types of coaxial cables to require dissipation factors of the order of 0.00010 with a precision of ± 0.00001 has taxed the performance of commercially available test equipment, such as the Boonton Radio Type 260-A Q meter. However, it has been demonstrated that by use of suitable high-Q inductors ($Q \approx 600$), the type 260-A Q Meter, when the "$\triangle Q$ feature" of this instrument is employed, is just adequate to meet the proposed new requirements. The Boonton Radio Type 192-A R-F Conductance Meter ("G Meter"), which is a commercial adaptation of the principle originally described by Weaver and McCool [2], is more than adequate to meet the requirements of the new specifications, but this instrument is not being manufactured at the present time.

2. Comparison of Performance of Different Test Instruments

Measurements on typical polyethylenes having various levels of dielectric loss have been conducted both within and between laboratories, and between different operators in the same laboratory. These have indicated that good agreement is obtainable at 1MC between the G Meter, which may be considered the referee method, and the Q Meter equipped with special high-Q inductors. Results of some of these measurements of dissipation factor, D, and dielectric constant, K, are shown in Table I and Table II. The high sensitivity of the G Meter is indicated by the following set of repeated measurements performed consecutively on a pair of representative plaques of a low-loss polyethylene. The conductance, G, measured in each test is recorded also.

Check Tests of Dissipation Factor and Dielectric Constant at 1MC, 24°C., by Benzene Cell Method: Repeated Measurements with Boonton Radio G Meter Type 192-A

Polyethylene Sample		D	K	G
[Desiccated 30 days over $CaCl_2$]	(a)	.000120	2.2814	.0997 μmho
	(b)	.000118	2.2807	.0984
	(c)	.000119	2.2807	.0991
	Averages:	.000119	2.2809	.0991

Table I shows results of a comparison of the Boonton 260-A Q Meter, employing a circuit Q of 600, and the Boonton 192-A G Meter in tests on ten typical polyethylene specimens.

* * *

The materials, (1) to (10), in Table I were not identical, so that variations from specimen to specimen are expected. The averages were determined only to show an over-all comparison between the two different instruments.

* * *

In order to determine reproduc-

TABLE I

COMPARISON OF DISSIPATION FACTOR AND DIELECTRIC CONSTANT MEASUREMENTS AT 1 MC, 24.0-24.5°C., BETWEEN Q METER AND G METER; WITHIN-LABORATORY TESTS

Polyethylene	Q Meter 260-A		G Meter 192-A	
	D	K	D	K
Sample (1)	.000142	2.2831	.000145	2.2826
(2)	.000133	2.2833	.000132	2.2826
(3)	.000138	2.2828	.000139	2.2824
(4)	.000128	2.2840	.000126	2.2830
(5)	.000129	2.2840	.000129	2.2836
(6)	.000138	2.2836	.000139	2.2832
(7)	.000144	2.2829	.000142	2.2819
(8)	.000137	2.2839	.000133	2.2826
(9)	.000138	2.2834	.000138	2.2833
(10)	.000134	2.2826	.000130	2.2820
Averages:	.0001361	2.28336	.0001353	2.28274

Note: Avg. D_Q - Avg. D_G = .0000008

Avg. K_Q - Avg. K_G = .00062

Average temp. for Q Meter tests, 24.00°C.; for G Meter, 24.33°C.

TABLE II

COMPARISON OF INDEPENDENT TESTS BY TWO OPERATORS: DISSIPATION FACTOR AND DIELECTRIC CONSTANT AT 1MC FOR REPRESENTATIVE POLYETHYLENE SPECIMENS BY BENZENE CELL METHOD, USING TYPE 260-A Q METER

Polyethylene	D(Dissipation Factor)		K(Dielectric Constant)	
	Operator A	Operator B	Operator A	Operator B
Sample (11)	.000078	.000078	2.279	2.279
(13)	.000088	.000085	2.279	2.279
(13)	.000254	.000264	2.278	2.279
(14)	.000234	.000238	2.278	2.279
(15)	.000180	.000173	2.277	2.278
(16)	.000172	.000166	2.276	2.279
(17)	.000168	.000160	2.276	2.278
(18)	.000142	.000154	2.276	2.280
(19)	.000076	.000075	2.278	2.278
(20)	.000104	.000110	2.280	2.280
(21)	.000143	.000148	2.277	2.278
(22)	.000167	.000162	2.278	2.280
(23)	.000255	.000258	2.279	2.280
Averages:	.0001585	.0001593	2.2779	2.2790

Note: Avg. D_A - Avg. D_B = -0.0000008
Avg. K_A - Avg. K_B = -0.0011

ibility of Q Meter test results between operators, thirteen typical specimens of low-loss polyethylene were measured independently by two different operators in our laboratory. The Boonton Type 260-A Q Meter with a high-Q inductor (Q = 600; resonating capacitance, 215 mmf. at 1MC)[3] was employed. Neither operator had seen the other's results until all tests were completed. The data in Table II show excellent agreement between operators for these specimens, (11) through (23), which had dissipation factors ranging between 0.00008 and 0.00025, approximately. All tests were run on the same day.

* * *

A new device to increase the sensitivity of the 260-A Q Meter has been developed in the laboratories of Union Carbide Plastics Company. Known as the "G Adapter", this plug-in equipment converts a standard Q Meter to a G Meter by applying a modification of the Weaver and McCool[2] principle referred to previously. In addition to enhancing the sensivity of the Q Meter, this G Adapter provides direct measurement of conductance, thereby greatly simplifying computations of dissipation factor. This apparatus will be described in a forthcoming paper [4]. Table III presents results of measurements on typical polyethylene specimens at 1MC by means of the G Adapter + 260-A Q Meter, by the 260-A Q Meter alone, and by the 192-A G Meter. The agreement among the three is considered to be quite satisfactory.

* * *

TABLE III

DISSIPATION FACTOR AND DIELECTRIC CONSTANT AT 1MC, 24°C., OF REPRESENTATIVE POLYETHYLENES BY THREE DIFFERENT METHODS

Sample	(1)Q Meter + G Adapter		(2)Q Meter Alone		(3)G Meter 192-A	
	D	K	D	K	D	K
A	.000108	2.2751	.000107	2.2767	.000106	2.2747
B	.000038	2.3542	.000031	2.3546	.000041	2.3530
C	.000034	2.3038	.000025	2.3041	.000034	2.3029
D	.000041	2.2980	.000040	2.2989	.000042	2.2974
E	.000118	2.2832	.000124	2.2834	.000123	2.2823
F	.000246	2.2866	.000254	2.2872	.000261	2.2863
G	.000140	2.2744	.000143	2.2744	.000143	2.2734

A more critical evaluation of the merits of the "benzene cell" method is provided by interlaboratory tests. Table IV presents data obtained independently at two different laboratories (Lab. X and Lab. Y) on ten samples of polyethylene covering a range of dissipation factors. Measurements were performed at both 100KC and 1MC, using the 260-A Q Meter and high-Q inductors. Data were exchanged between laboratories after all tests and calculations were completed.

TABLE IV

INTERLABORATORY TESTS ON POLYETHYLENE SPECIMENS AT 100KC AND 1MC, 23°C., USING "BENZENE CELL" METHOD AND TYPE 260-A Q METER

Sample No.	Test Freq.	Dissipation Factor Lab. X	Dissipation Factor Lab. Y	Dielectric Constant Lab. X	Dielectric Constant Lab. Y
(24)	100KC:	.000112	.000108	2.2859	2.2892
	1MC:	.000118	.000113	2.2853	2.2884
(35)	100KC:	.000108	.000110	2.2831	2.2816
	1MC:	.000107	.000118	2.2819	2.2817
(26)	100KC:	.000206	.000214	2.2884	2.2891
	1MC:	.000160	.000156	2.2866	2.2890
(27)	100KC:	.000206	.000201	2.2893	2.2891
	1MC:	.000163	.000160	2.2887	2.2884
(28)	100KC:	.000180	.000177	2.2918	2.2882
	1MC:	.000140	.000141	2.2896	2.2879
(29)	100KC:	.000119	.000118	2.2857	2.2865
	1MC:	.000117	.000114	2.2853	2.2860
(30)	100KC:	.000123	.000108	2.2819	2.2822
	1MC:	.000126	.000122	2.2814	2.2820
(31)	100KC:	.000127	-	-	-
	1MC:	.000135	.000121	2.2820	2.2818
(32)	100KC:	.000122	.000113	2.2825	2.2815
	1MC:	.000133	.000126	2.2819	2.2815
(33)	100KC:	.000115	.000109	2.2821	2.2818
	1MC:	.000127	.000128	2.2819	2.2818

Table IV shows remarkably close agreement between the two laboratories in the dissipation factor measurements at both 100KC and 1MC. Agreement of dielectric constant values for some of the specimens having relatively high dielectric constants is not as good as it might be, but the few discrepancies have not been followed up since the agreement was excellent in the majority of cases.

III. Effect of Specimen Preparation and Density on Dielectric Properties of Polyethylene

1. Thermal Aging

It has been recognized for some time that the physical properties of polyethylene are affected by the rate of cooling from the melt in the molding operation. In a recent paper, Birks and Rudin[5] of Canadian Industries Limited (CIL) have discussed the control of the thermal history of compression molded polyethylene test specimens, and have suggested standardized procedures for shock-cooling and slow-cooling. ASTM Committee D-20 on Plastics is working on standardization of a proposed method for preparation of compression molded polyethylene test specimens, following the proposals of Birks and Rudin.

* * *

In this paper any reference to "fast-cooled" specimens refers to relatively quick cooling of the molded plaques in the mold and not to the shock-cooling method described in Reference (5). "Slow-cooled", however, does refer to the technique of cooling from the melt at a rate of 5°C. per hour in accordance with the Birks and Rudin (or CIL) method.

* * *

Table V shows the effect of "fast" and "slow" cooling on the density and dielectric constant of typical polyethylene specimens. Dissipation factors are in general found not to be significantly affected by the cooling rate, according to considerable experimental evidence. The density and dielectric constant, however, are both shown (Table V) to be about 0.5% higher

TABLE V

TYPICAL DENSITY AND DIELECTRIC CONSTANT DATA, AT 23°C., FOR FAST-COOLED AND SLOW-COOLED POLYETHYLENE MOLDED SPECIMENS

Sample No.	Fast-Cooled* Density	Fast-Cooled* Diel. Const.	CIL Slow-Cooled** Density	CIL Slow-Cooled** Diel. Const.
(34)	.9188 gm/cm^3	2.274	.9236 gm/cm^3	2.285
(35)	.9188	2.274	.9238	2.284
(36)	.9184	2.274	.9241	2.285
(37)	.9185	2.274	.9242	2.285
(38)	.9184	2.273	.9235	2.287
Averages:	.9186	2.274	.9238	2.285

* - Cooled in mold in about 3 minutes.

** - Cooled from melt at 5°C. per hour.

TABLE VI

EFFECT OF ADDITION OF ANTIOXIDANT (SANTONOX R) ON ELECTRICAL PROPERTIES OF TWO POLYETHYLENE SAMPLES AT 1MC, 23°C.

Specimen Molded From:	Santonox R Content, %	Sample (39) D	Sample (39) K	Sample (40) D	Sample (40) K
(a) Pellets	0	.000078	2.279	.000076	2.278
(b) Milled Sheet	0	.000088	2.279	.000104	2.280
(c) " "	0.05	.000142	2.276	.000143	2.277
(d) " "	0.10	.000172	2.276	.000167	2.278
(e) " "	0.15	.000234	2.278	.000255	2.279

for the slow-cooled specimens.

2. Effect of Density of Polyethylene on Dielectric Constant

Lanza and Hermann[6], referencing work by McCall[7], have shown that to a close approximation the dielectric constant K vs. density ρ relationship for polyethylene at 23°C. is given by the following linear equation:

$$K = 2.276 + 2.01\,(\rho - 0.9200), \text{ Eq. (1)}$$

which can also be written

$$K = 2.01\rho + 0.4268 \quad \text{Eq. (1a)}$$

* * *

Eq. (1) is based on a considerable amount of experimental evidence that the best value for the dielectric constant of polyethylene of density 0.9200 gm/cm^3 is 2.276, at 23°C. The slope, 2.01 cm^3/gm, is derived from the Clausius-Mozotti equation (see below) by differentiation with respect to ρ; or it can be obtained graphically by determination of the slope of the best straight line through a plot of K vs. ρ for the range of densities between 0.9100 and 0.9600 gm/cm^3.

* * *

Theoretically, the dielectric constant vs. density relationship is expressed with more physical correctness by the Clausius-Mozotti equation

$$\frac{K-1}{K+2} \times \frac{M}{\rho} = \frac{4\pi N\alpha}{3} \quad \text{Eq. (2)}$$

where M is the molecular weight; ρ is the density; N is Avorgadro's number; and α is the molecular polarizability. An excellent condensed treatment of this subject is given by Le Fevre. [8]

* * *

Eq. (2) can be rewritten

$$K = \frac{1+2B\rho}{1-B\rho}, \quad \text{Eq. (2a)}$$

where $B = \dfrac{4\pi N\alpha}{3M}$, a constant for a given non-polar substance like polyethylene.

* * *

From the experimental observation that K = 2.2760 for ρ = 0.9200 gm/cm^3, at 23°C, the value of B is found to be 0.3244 cm^3/gm, very nearly, for polyethylene. Eq. (2a) then becomes

$$K = \frac{1 + 0.6488\rho}{1 - 0.3244\rho} \quad \text{Eq. (2b)}$$

* * *

While Eq. (2b) is obviously not linear, for small ranges of density ρ, say from 0.91 to 0.96 gm/cm^3, a plot of K vs. ρ is essentially linear to within the experimental error with which the dielectric constant can be measured, and values agree with those calculated by the Lanza and Herrmann formula to within a few digits in the fourth decimal place.

* * *

When ρ is set to zero in Eq. (2b), K = 1.00. This is not true of Eq. (1). Eq. (2b) is therefore the more physically correct expression of the dielectric constant vs. density relationship, but Eq. (1) is a useful working formula for application within narrow boundary conditions (for densities of 0.91 to 0.96 gm/cm^3, approximately).

3. Effect of Temperature on Dielectric Constant of Polyethylene

The change of the dielectric constant of polyethylene with temperature obviously is governed by the change of density with temperature. Since the density decreases with increasing temperature, the dielectric constant will decrease with rising temperature. The rate of change of dielectric constant with temperature is a function of the thermal cubical expansion coefficient. Relative volume vs. temperature data for polyethylene have been published by Clash and Rynkiewicz[9]. Thermal expansion characteristics of polyethylene have also been published by Hahn, Macht, and Fletcher [10], who indicate a mean coefficient of cubical expansion of 725 x 10^{-6} per °C. in the temperature range 20 to 25°C. This value agrees closely with the value of 719 x 10^{-6} per °C. at 20°C., as calculated by Clash and Rynkiewicz. More recent investigations of the thermal cubical expansion of polyethylene have been reported by Mandelkern, Hellman, Brown, Roberts, and Quinn[11] .

* * *

The thermal cubical expansion coefficient of polyethylene increases rapidly with increasing temperature below the melting point, but for a given small temperature interval a mean value may be treated as a constant for practical purposes. Since the density of a given mass of a substance varies inversely as its volume, the density ρ at temperature (23 + $\triangle$T) °C. will be related to the density ρ23 at 23°C. as follows:

$$\rho_{(23+\triangle C)} = \frac{\rho_{23}}{(1+K.\triangle T)} \quad \text{Eq. (3)}$$

where k is the cubical expansion coefficient and $\triangle$T is a small temperature change of a few degrees C. within the temperature interval for which k may be regarded as essentially a constant. A more readily usable form of Eq. (3) is obtained by multiplying the numerator and denominator to the right hand side by (1 — k. $\triangle$T), which gives the approximate relation

* * *

$$\rho_{(23+\triangle T)} = \rho_{23}\,(-K.\triangle T) \quad \text{Eq. (3a)}$$

Eq. (3a) is sufficiently accurate for all practical purposes, since the term $(1 - k^2 . \triangle T^2)$ is insignificantly different from unity because $k^2 . \triangle T^2$ is very small.

* * *

By combining Eq. (3a) with the Lanza-Herrmann formula, Eq. (1), it can be shown that, for the temperature range between 20 and 25°C.,

$$K_{23} = K_{(23+\triangle T)} + 0.00134 . \triangle T \quad \text{Eq. (4)}$$

* * *

Eq. (4) is a means of correcting dielectric constant values for polyethylene specimens measured at temperatures different from 23.0° C., provided that the test temperature differs from 23.0°C. by only a few degrees. In Eq. (4), $\triangle T$ may be either positive or negative. The "benzene cell" method (ASTM D 1531) provides for temperature correction of the dielectric constant of benzene, based on data by Hartshorn, Parry, and Essen.[12] Since the correction per °C. for the dielectric constant of polyethylene is approximately two-thirds of that for benzene, it may be large enough to be practically significant also, when tests are made at slightly different temperatures by the "benzene cell" method.

IV. Effects of Antioxidants on Electrical Properties of Polyethylene

The statement has been made in the literature that the addition of small amounts of antioxidants to base polyethylene resins has insignificant effects on the electrical properties. Numerous recent tests, however, show that the effect of some antioxidants is indeed significant and that the addition of as little as 0.1% may increase the dissipation factor at 1MC by 100% or more. Other types of antioxidants are found to produce much smaller, though usually detectable, increases in the dissipation factor.

* * *

Table VI shows electrical data for two typical polyethylene resin samples into which different amounts, up to 0.15%, of antioxidant 4-4'-thiobis-(2-tertiary butyl-5 methyl-phenol), designated commercially as "Santonox R", had been incorporated by milling on a two-roll mill. The influence on dissipation factor is quite marked, although the dielectric constant apparently was virtually unaffected by the addition of the antioxidant. The amount of Santonox R normally used in commercial compounds is 0.10%.

* * *

The effect on dissipation factor of the addition of antioxidant N-N'-diphenyl, p-phenylene diamine, known commercially as "JZF", to milled sheets of polyethylene in amounts up to 0.10% is shown in Table VII to have been slight, but detectable.

TABLE VII

EFFECT OF ANTIOXIDANT "JZF" ON DISSIPATION FACTOR OF POLYETHYLENE AT 1MC

Sample No. (41):	"JZF" Content, %	Dissipation Factor
(a)	0	.000072
(b)	0.05	.000076
(c)	0.07	.000084
(d)	0.10	.000093

V. Effects of Moisture on Electrical Properties of Polyethylene

The effect of moisture on the electrical properties of polyethylene is usually represented as very slight or negligible, but recent experimental evidence shows that this assumption is not universally true. With some specimens very marked effects of moisture on both dissipation factor and dielectric constant of polyethylene compounds have been observed, and these observations have been verified repeatedly and reproducibly. In other cases, however, long immersion of molded polyethylene specimens in water has produced insignificantly small or negligible effects on the dielectric properties. It is impossible, therefore, to make a positive general statement one way or the other about polyethylene with respect to the effect of water immersion on electrical properties. A similar conclusion seems to hold for different specimens molded from a given polyethylene compound, suggesting that the differences in behavior with regard to the effects of exposure to water most likely result from molding variables. There are numerous aspects of this problem, and many unanswered questions relating to it, that require more thorough investigation. The data presented in this paper are considered to be in the nature of a progress report, primarily for the purpose of pointing out that with the improved electrical measuring techniques now available many effects not previously detectable with certainty can now be measured readily.

* * *

The work in our laboratory relating to the effect of moisture on the electrical properties of poly-

TABLE VIII

EFFECT ON ELECTRICAL PROPERTIES, AT 100KC AND 1MC, 23°C., OF DESICCATION AND WATER IMMERSION OF POLYETHYLENE SAMPLES PROCESSED FROM ORIGINALLY "WET" PELLETS (TESTS PERFORMED CONSECUTIVELY IN ORDER LISTED)

CONDITIONING	Test Freq.	Sample (42) D	Sample (42) K	Sample (43) D	Sample (43) K	Sample (44) D	Sample (44) K	Sample (45) D	Sample (45) K
(a) As Originally Molded	100KC	-	-	-	-	-	-	-	-
	1MC	.000170	2.2813	.000307	2.2805	.000197	2.2767	.000221	2.2767
(b) Stored 13 Days Room Cond.	100KC	-	-	-	-	-	-	-	-
	1MC	.000156	2.2788	.000295	2.2802	.000196	2.2760	.000228	2.2760
(c) Desiccated 6 Days $CaCl_2$	100KC	-	-	-	-	-	-	-	-
	1MC	.000090	2.2782	.000197	2.2789	.000184	2.2752	.000203	2.2752
(d) After 14 Days in Water, 23°C.	100KC	.000115	2.2874	.000341	2.2887	.000232	2.2770	.000358	2.2776
	1MC	.000357	2.2860	.000384	2.2878	.000214	2.2770	.000260	2.2764
(e) Re-tested after 2 hrs., 50% RH	100KC	.000122	2.2879	.000360	2.2881	.000242	2.2771	.000335	2.2765
	1MC	.000360	2.2866	.000374	2.2881	.000206	2.2767	.000248	2.2764
(f) Re-tested after 24 hrs., 50% RH	100KC	.000106	2.2819	.000319	2.2836	.000222	2.2754	.000312	2.2755
	1MC	.000258	2.2806	.000332	2.2832	.000205	2.2751	.000236	2.2754
(g) Desiccated 3 Days, $CaCl_2$	100KC	.000123	2.2797	.000282	2.2812	.000176	2.2764	.000247	2.2764
	1MC	.000098	2.2796	.000238	2.2804	.000170	2.2760	.000194	2.2756
(h) Desiccated 7 Days, $CaCl_2$	100KC	-	-	-	-	-	-	-	-
	1MC	.000093	2.2795	.000195	2.2800	.000176	2.2747	.000200	2.2752

ethylene has been of two rather distinct types. In one type of investigation the effect of desiccation over $CaCl_2$ of specimens known to contain, or suspected of containing, molded-in moisture was studied; in the other, molded 50-mil plaques were tested after successive periods of desiccation and water-immersion at room temperature.

* * *

The data presented in Table VIII were obtained from tests made on specimens molded from "wet" pellets, or from sheet milled from "wet" pellets with and without antioxidant. The degree of original "wetness" of the different samples was variable and uncontrolled. Sample (42) was molded directly from the pellets, with no antioxidant. Samples (43), (44), and (45) were molded from sheets milled from the "wet" pellets and all three contained antioxidant (Santonox R). Milling would be expected to expel the free moisture.

* * *

Of all the samples in Table VIII, Sample (42) molded directly from the original "wet" pellets without antioxidant showed the most remarkable behavior. Its dissipation factor after 14 days of immersion in distilled water was lower at 100KC than the dissipation factor at 1MC before immersion. Possibly the most unexpected result for Sample (42) is the fact that after water immersion for 14 days the dissipation factor at 100KC was only about one-third as high as the corresponding value at 1MC. No simple explanation for this phenomenon is immediately apparent, but it would be interesting to perform electrical measurements on this specimen over several decades of frequency.

* * *

A further check test on the effect of molded-in moisture from "wet" pellets was performed. A 50-mil plaque was molded from a portion of a lot of "wet" pellets, and its dissipation factor and dielectric constant at 1MC, 22.0°C., were found to be 0.000181 and 2.2746, respectively. Some additional pellets from the same lot were then dried for 1 hour in a forced-draft oven at 75°C. before molding into a 50-mil plaque. Specimens cut from this second plaque were found to have a dissipation factor of 0.000096 and a dielectric constant of 2.2749 at 1MC, 21.7°C. This experiment leaves little doubt that surface moisture on pellets is not fully expelled during compression molding. Aluminum foil parting sheets were used for both of the moldings just described.

* * *

A still further experiment to investigate the effect of water-immersion on typical low-loss poly-

(*Please turn to page* 1580)

TABLE IX

EFFECT OF IMMERSION OF POLYETHYLENE IN WATER AT 23°C., AND SUBSEQUENT DESICCATION, ON ELECTRICAL PROPERTIES AT 1MC

DISSIPATION FACTOR (D) AND DIELECTRIC CONSTANT (K) AT 1MC

CONDITIONING	Sample (46) D	Sample (46) K	Sample (47) D	Sample (47) K	Sample (48) D	Sample (48) K	Sample (49) D	Sample (49) K	Sample (50) D	Sample (50) K
(a) Original-Dry	.000145	2.2826	.000126	2.2830	.000129	2.2836	.000130	2.2820	.000147	2.2834
(b) After 4 Days in Water 23°C.	-	-	-	-	.000127	2.2838	-	-	.000150	2.2835
(c) After 29 Days in Water, 23°C.	.000143*	2.2834	.000127*	2.2838	.000130	2.2835	.000130*	2.2838	.000149	2.2844
(d) Desiccated 30 Days, $CaCl_2$	.000129	2.2818	.000114	2.2818	.000116	2.2812	.000119	2.2807	.000126	2.2817

*NOTE: Immersed in sea water instead of distilled water.

TABLE X

EFFECT OF WATER-IMMERSION AND DESICCATION ON ELECTRICAL PROPERTIES OF POLYETHYLENE
DISSIPATION FACTOR (D) AND DIELECTRIC CONSTANT (K) AT 100KC & 1MC
TESTS PERFORMED CONSECUTIVELY IN ORDER LISTED

CONDITIONING	Test Freq.	Sample (51) D	Sample (51) K	Sample (52) D	Sample (52) K	Sample (53) D	Sample (53) K	Sample (54) D	Sample (54) K
(a) Original-Dry	100KC	.000112	2.2859	.000206	2.2893	-	-	-	-
	1MC	.000118	2.2853	.000163	2.2887	.000122	2.2728	.000096	2.2736
(b) After 14 Days in Water, 23°C.	100KC	.000198	2.2877	.000341	2.2914	-	-	-	-
	1MC	.000163	2.2874	.000238	2.2902	.000125	2.2727	.000123	2.2746
(c) After 24 hrs. @50% RH 23°C.	1MC	.000127	-	.000184	-	.000115	-	.000100	-
(d) Desiccated 25 Days, $CaCl_2$	1MC	.000107	2.2857	.000149	2.2885	.000110	2.2721	.000094	2.2736
(e) After 30 Days Additional in Water, 23°C	1MC	.000159	2.2875	.000242	2.2903	.000116	2.2728	.000120	2.2728
(f) Desiccated 14 Days, $CaCl_2$	1MC	.000110	2.2862	.000153	2.2853	.000106	-	.000095	-

TABLE XI

EFFECT OF WATER IMMERSION ON POLYETHYLENE
DISSIPATION FACTOR AND DIELECTRIC CONSTANT AT 1MC
TESTS PERFORMED CONSECUTIVELY IN ORDER LISTED

CONDITIONING	Sample (55) D	Sample (55) K	Sample (56) D	Sample (56) K
(a) Original-Dry	.000124	2.280	.000127	2.280
(b) After 14 Days in Water, 23°C.	.000133*	2.2804	.000139	2.2796
(c) After 45 Days in Water, 23°C.	.000139*	2.2790	.000133	2.2808
(d) Desiccated 14 Days over $CaCl_2$	.000120	-	.000116	-

*NOTE: Immersed in sea water instead of distilled water

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LB 8

Planning and Scheduling in the Wire Mill

by Harold L. Komoski
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This paper was presented at the Annual Convention of The Wire Association on November 15, 1960, at Chicago, Illinois.

Before developing several aspects of Wire Mill planning and scheduling, let me present first a brief sketch of our set-up at Roebling. Our Wire Mill is primarily a high carbon mill, low carbon being a very minor percentage of the tonnage. Normal employment is approximately 850 men, productive and supervisory. With a very good order mix, the Mill can ship approximately 4,000 tons per week, but normally operates during a good business cycle at a 3,200 to 3,500 ton level. The products shipped are very diversified and include most grades of Bright Hard Drawn and Heat Treated Spring Wire and many special grades of High Carbon Specialties such as Rope, Strand, Hose, Tire Bead and Grease Gun Wire.

* * *

Nine 45-ton Open Hearth Furnaces produce acid and basic steel. A 3-high Blooming Mill and a Morgan Continuous Billet Mill roll 2″ and 4″ billets for the rod mills. The #1 Rod Mill is a 3 strand continuous Morgan mill, and rolls a 30′ 2″ x 2″ billet into 380# c.w. rods, .187″ to .350″ in diameter. Steps are under way, however, to convert to $2\frac{5}{16}$″ billets and a 600# rod coil. The #2 Hand Looping Rod Mill rolls the 4″ x 4″ steel and copper billets into diameters .375″ to .500″.

* * *

The rods supplied to the Wire Mills are rolled in a cycle rolling: .187″, .218″, .250″, .281″, .312″ and .350″. The cycle runs from 20 to 24 operating shifts and includes flats for our C.R.P.D. and rods for outside customers. This cycle presents problems of scheduling to the Wire Mills — when, for instance, the Rod Mill rolls a 20 shift week, the Wire Mill has available to it a full supply of diameters in seven working days. If business diminishes and the Rod Mill operates, say 12 turns, then the Wire Mill waits two calendar weeks for its full supply.

* * *

The Wire Mill rod inventory will vary in tonnage depending on the problems of the moment, but normally we attempt to stabilize between 4,500 to 5,000 tons. This amount, at a good operating level is a 10 day supply; we try to maintain this amount at all times. It is essential to maintain a full variety of rod sizes and a wide choice of carbons and analyses to enable the mill to satisfy all customer demands for quick delivery. And those demands, as we all know, can be stridently imperative during a period of customer inventory reduction as we have experienced recently.

* * *

Each individual Wire Mill is different in its physical set-up and working procedures, and suggestions that may be of some purpose to our mill may be of small value to another mill. Planning and scheduling, however, encompass the entire area of every mill and all systems, and though one cannot look to change an entire system, it is possible to review procedures and make alterations and improvements. With this in mind, I submit three major areas for your attention:

1. **A method of determining capacity**
2. **Improving the Sales-Production relationship**
3. **A review of actual mill scheduling**

* * *

A Wire Mill is a composite of several kinds of capacities—patenting, annealing, cleaning, ripping, dry drawing, wet drawing and a variety of others. The operations may vary, and processes may be changed or by-passed, but it remains that the finish drawing capacity is the one that determines the mill's ability to ship.

* * *

There are, of course, several methods of arriving at a capacity figure. The method we chose was to start with the total of the mechanical capabilities of the machines. Each wire drawing machine has a minimum and maximum diameter that it can draw successfully. These mechanical limitations are then adjusted by a variety of other practical considerations; for instance, a machine may be capable of drawing a rod diameter, but the coils may not be sufficiently large to permit welding rods quickly enough to keep the machine going continuously. Incentive rate structure problems impose further limitations; here, for example, a machine may be capable of drawing .155″ dia. finish spring wire, but the work load on the man may be extreme, which makes it contractually difficult to rate. Examples such as these can be found in any mill, and are individual with each mill, and they must be treated in relationship to that particular mill's overall nature.

* * *

Having established the mechanical, practical and incentive limitations of the equipment, the equipment is now separated into drawing ranges by diameter.

* * *

In the Roebling Mills the ranges are:

.004″ - .017″ — 8″ Coils, Spools and Cores

.018″ - .031″ — 12″ Coils, Spools and Cores

.032″ - .059″ — 16″ Coils, Spools and Cores

.060″ - .083″ — 22″ Coils and Spools
.084″ - .119″ — 22″ and 30″ Coils and Spools
.120″ - .437″ — 30″ Coils and Spools

* * *

The finish block sizes are standard, but these can be varied by special block sizes, and block sizes can in some cases overlap into adjacent ranges.

* * *

The tonnage of each wire drawing machine is summarized into the diameter range or ranges of its drawing capacity. A machine's tonnage may be, for example, 300 tons, and this tonnage is spread over three ranges — 30 tons in the finer end of its range, 200 tons in the heart of its range, and 70 tons in the coarser end. This separation into ranges can be determined either by checking thru the daily records of mark-up or actual drawing records. Either will suffice: the mark-up records are handier and more readily analyzed, while the wire drawing records will reflect all the minor changes and variations made in the mill, which will not, however, noticeably distort the overall tonnage. We have found that quarterly reviews suffice to keep abreast of mill changes, and that such periodic chores are more easily accomplished than by doing such a review on a daily basis. This summary of the tonnages of each of the machines or machine groups into diameter ranges will give the total wire drawing capacity of the entire mill by ranges.

* * *

With the total drawing capacity now ascertained, there remains the important step of deciding how much of that drawing is reserved for ripping.

* * *

By definition, "rip", in our mill, generally means the operation that is preparatory to (1) an intermediate patenting or (2) a further drawing. "Finish" drawing is accepted as being the last drawing preparatory to galvanizing, annealing, tempering, or bundling for shipment.

* * *

A preliminary total of the rip tonnage can be determined by estimating the total of the tonnages of the finishing operations, that is, galvanizing, tempering, and annealing, and deducting this from the total drawing capacity. But this figure will be faulty, because of changes in mix and changes brought on by seasonal variations. If all equipment is running at the finer end of its range, then all totals will be on the lighter side. And, historically, the new year brings sizable increases in rope and strand wire, while summer and fall are the big spring wire periods. Thus, the variables in the several finishing operations make it difficult to arrive at a highly accurate figure for ripping. Consequently, we have found that a repeated checking quarter by quarter thru several seasons of the actual tonnages marked up for ripping as against tonnages marked up for finishing has enabled us to arrive at an adjusted figure for the finishing operations that is highly accurate. And now, having a set of figures for finish tonnage by size ranges that is proved to be within the abilities of the Mill, these figures are formalized into a report that is submitted to the Sales Department for its use and guidance in selling the Mill's tonnage.

* * *

With this information on capacity as provided by the Mill Production Department, the Sales Department, after examining, discussing and eventually agreeing to the ranges and tonnages available, will do its utmost to sell all the capacity or, as a minimum, sufficient tonnage to keep the Mill at a profitable operating level. An item that has proved to be of great value in this area is the forecast of sales. This indicates to the Mill the tonnage by range and product line that the department anticipates selling during the ensuing quarter. This cues Mill Management to the operating level that will be necessary to satisfy customer demand. If the forecast is optimistic, then production immediately takes steps to increase the Mill output to meet demand.

* * *

The accuracy of the forecast and the actual tonnage of orders entered are doubly reviewed (1) by the Sales Department which issues a report of orders entered against the forecast, and (2) by the Mill in tonnage as received weekly. If the order level, as forecast, is maintained, then the Mill will experience no difficulty in shipping the required tonnage; if orders slack off and the forecast proves to be too optimistic, then the Mill immediately takes steps to compensate for the deficiency of tonnage.

* * *

This leads to the mention of an area that is of major importance: the relationship that exists between Sales and Production. With Sales striving continuously to sell more and more profitable tonnage, and the Mill seeking to increase tonnage and productivity while cutting costs, there is frequent opportunity for friction to develop. The Sales Department's failure to meet its forecast, or the Mill's failure to produce the required tonnage, or a falling off of quality and an increase of complaints — any of these can breed dissatisfaction and recrimination. That is why it is essential that this Sales-Production relationship be one of mutual respect and understanding. It is just as simple as that. I am sure that everyone will agree that a mutual respect for each other's abilities, needs and shortcomings is one of the essentials of progress and peace, be it for individuals, States, or company divisions. Cooperation by Mill Management and the Sales Managers must be the keystone.

* * *

Furthermore, sincere efforts must be made to achieve full understanding as to the areas of responsibility that devolve to each. Sales gripes from individual salesmen and from the districts must be funneled into the Home Office. Criticisms and complaints to the mill should be handled only by the top level of Sales and by them to the Managers of the mill. The men at these levels can best offer sympathetic understanding of all the details of the other man's problems. The Mill problems are the problems of the Sales Managers, and the Sales problems are for the Mill to solve. But they must be discussed and solved by the proper personnel. Interference in the Mill by people from out in left field is not to be desired.

* * *

When this mutuality exists, then

it is simple for both parties to agree on Mill operating levels during changes in business cycles. Or to put it another way, Sales must not oversell the Mill when the market is ripe for picking. During such a period as we had a year ago last spring, it was very easy for Sales to sell twice the capacity of any Mill. In periods like this, it behooves the Sales Department to understand that there is a limit to capacity. But then, similarly, the Mill must accept Sales' inability to fill all the Mill's finishing operations when the market is slack as it is at the present time. When business is good, the Mill makes orders to the limits of its capacity — and when business slackens, then the Mill should extend its concern to making orders and stock. And if conditions further warrant, then the Mill should reactivate its several programs of experimentation and development. There is a right time for everything. And with a good relationship between Sales and Production, the right time is with us always.

* * *

The actual scheduling of orders through the Mill processes seldom presents any problems. The mechanics of scheduling can be solved. If the capabilities of the Mill and its equipment are carefully analyzed and understood, if the planning and forecasting has been accurate, and if that understanding relationship exists between Sales and the Mill, then scheduling customer's orders thru to a requested shipping date requires a minimum of attention. It is only when errors of serious degree have been made in estimated capacities or in forecasted tonnages that problems follow. It is essential that the Sales Orders as entered on the Mill be accumulated into weekly totals by calendar request dates and product lines, and checked against the Mill's capacities and the Sales forecast. This tonnage is weighed against the operating level of the Mill, and a weekly check is thereby kept on the overall performance. And right here is where action must be swift and sure: If Sales is overshooting the forecast, the Mill must move up quickly lest delinquencies accumulate — and if Sales undershoots, then the Mill retrenches to the most economical level possible to preserve its profits.

* * *

The incoming tonnage, then, is reviewed as received. It then passes directly to the Supervisors of Scheduling who direct the actual detail scheduling of the Mill. Here, the delivery promises are determined and returned to the Sales Department.

* * *

All Mill manufacturing is done from a Standard Manufacturing Practice, which is applied to the order — a variable header containing information from the face of the Sales Order is prepared and incorporated into the Standard Manufacturing Practice, which, incidentally, is supplied, as required, by the Metallurgical Department after approval by the Manufacturing Manager. All the necessary copies are prepared, duplicated and delivered to the Backlog Clerk.

* * *

The Standard Manufacturing Practices, now identified by customer through the variable headers, are accumulated by product and by month in the Backlog Section. As orders are required to maintain the preestablished working level of the Mill, the Backlog Clerk forwards the next month's accumulation to the Schedule Heads.

* * *

The Schedule Heads, working in close conjunction with the Scheduling Supervisors establish the order of preference of manufacturing. Orders are analyzed and segregated by product lines and diameters, and after being reviewed, are held ready for release to production.

* * *

The rod stock is examined for rod availability. If rods are available, the amount necessary to complete the order is reserved. If rods are not available, a rod order is written on the Rod Mill. Rod orders are accumulated into a weekly order, the size of the total order being determined by the level of operation in the Mill.

* * *

The unloading of rods, as received from the Rod Mill, is controlled by the Schedule Clerks who designate whether the rods are to be unloaded at the furnaces for patenting, into the cleaning line for raw rod usage, or put into temporary storage.

* * *

The introduction of any order into production is determined by the date requested, by Sales pressure, by the necessity of maintaining a balanced load in the Mill, by the percentage of the Mill occupied with ripping for subsequent operations in other finishing departments, and only with the approval of the Scheduling Supervisors. It is only because the Scheduling Supervisors maintain a constant review of order backlogs that they are in a constantly ready position to answer any inquiries, and to promise delivery of new orders. The attention to detail at this point is essential to success in avoiding delinquencies; it is the keystone to a well-organized and cost-conscious mill. Check, review, and check again.

* * *

The daily scheduling of the wire drawing equipment is prepared by Schedule Clerks who inventory the wire drawing stock available at the machine, and estimate the machine requirements for the next 24 hours. These requirements are satisfied by the Schedule Heads who select orders to satisfy the demands of the various groups of finishing and ripping machines. Furnace schedules are adjusted at this time to provide patented rods or patented wire as required.

* * *

The Schedule Clerks prepare and deliver to the wire drawing machines all the necessary travel tag sets, the machine order assignment schedules, the cleaning tickets and schedules to the cleaning departments, and scale cards for order weigh-up to the mill scales. As wire is weighed at the scales, the clerks check the cards to ascertain when an order has been completely drawn. The wire for each order, when weighed, is delivered to the Shipping Preparation Department, where it is tested, bundled, inspected and accumulated for truckload or carload shipment.

* * *

The finishing operations of specific product lines, such as, galvanizing, oil tempering and annealing,

(*Please turn to page* 1593)

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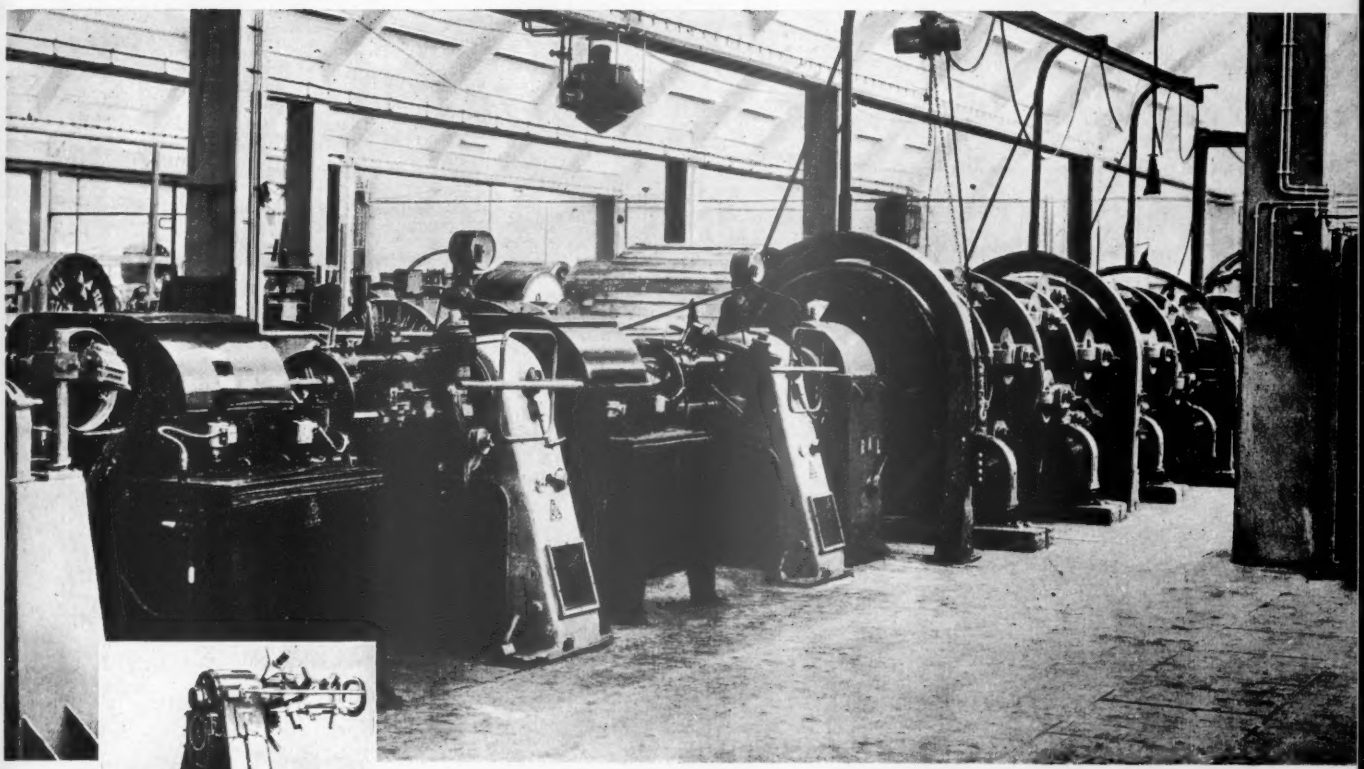

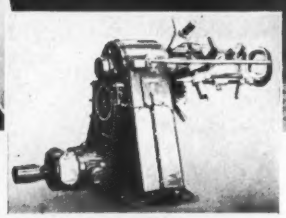

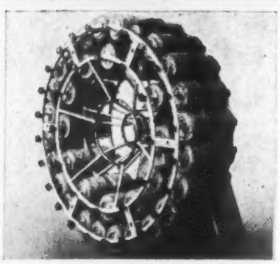

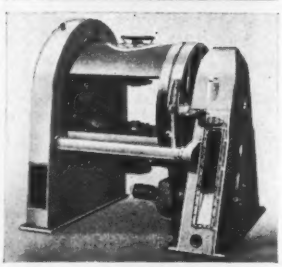

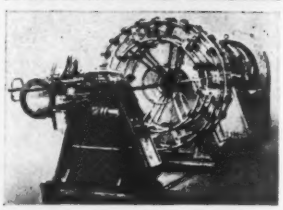

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Cold Extrusion of Steel Parts from Wire

by Alfred Braun
Secretary-Treasurer
Braun Engineering Company
Detroit, Michigan

This paper was presented at the Annual Convention of The Wire Association November 15, 1960, at Chicago, Illinois. The author is a design engineer by profession. He secured his technical education in various local colleges, but his education in cold extrusion has come from practical experience. His company probably was the first to supply the automotive industry with cold extruded products and of these they ship about 400 thousand each day. They also are responsible for the development of the cold extrusion slug on a cold header, that made the extrusion of small parts economically feasible. This is what Mr. Braun describes in his paper.

In cold extrusion one of our main problems is to obtain a cheap, good billet to put into the extrusion die. This is where wire comes in.

* * *

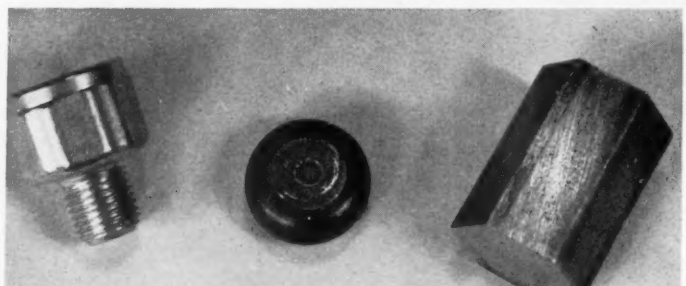
In the early days of cold extrusion, about 1948, the only method of producing slugs available to us, was to punch circular discs out of plate. The problems were enormous. Thirty per cent waste in the remaining skeleton is the first obvious problem. Tolerance on plate thickness is so considerable that for one job with a closed cavity die, we had to sort the plate into five different piles of material before punching the billet out. We would vary the diameter of the billet to compensate for thickness variation of the plate in order to obtain a constant volume in the billet. We would start with the thinnest pile of material using the largest possible diameter punch and die, then for the next thicker pile of material, use a little smaller punch and die diameter and so on through the five piles. If the plate varied within permissible limits from side to side or end to end, we just couldn't use it.

* * *

We felt sure that cold heading from wire was the proper approach to overcome these difficulties. After many discouragements by cold heading, experts as well as our own failures, we finally overcame the difficulties of cold heading the slug. This made possible the high production of low cost extrusions and is the method generally in use today.

* * *

All waste, such as from the aforementioned skeleton was eliminated. By lengthening or shortening the feed stroke on our header, we can compensate for variations in wire diameter. Now that we draw our wire with an Ajax Hogue unit right at the header, we are even assured of a uniform, constant diameter being fed in, except for very slow die wear which is easy to compensate for. The wire we use ranges in size from $\frac{7}{16}$" to $\frac{7}{8}$" in diameter.



Left: Finished stop lamp switch housing. * * * * * * * * * * * *
Center: Material we use — 70# per M. * * * * * * * * * * * *
Right: Material formerly used — 404# per M. * * * * * * * * * *

The first illustration shows an ordinary job, namely, a stop lamp switch housing. We start with a 1008 hot rolled rimmed steel rod approximately $\frac{5}{8}$" in diameter. The rod is stored outdoors. Just before use, it is brought in and —

1. **Alkali Cleaned**
2. **Rinsed**
3. **Flash Pickled**
4. **Rinsed**
5. **Rinsed**
6. **Bonderized**
7. **Rinsed**
8. **Bondelubed**

* * *

As mentioned before, the wire is then drawn at the header, sheared to weight (weight and volume being synonymous for our purposes, weight being so much easier to check), and upset to desired diameter, approximately 1 inch.

* * *

The slug then is headed at rates from 160 to 180 per minute. Extreme caution and rigid inspection must be maintained at this point. It is impossible to make a concentric extrusion from an eccentric blank. The weight of the slug is watched very closely, especially on slugs that will be extruded in a totally confined extrusion die. The effects of an oversize slug in these instances on the tools and cranks of presses is devastating. It is often more difficult to produce a good slug than to produce a good extrusion. In order to maintain size control in the extrusion operation, we find it necessary to load the yield in slugs from each coil of rod in separate containers and hold them separate from this operation through the extrusion operation.

* * *

The reason for this is the inconsistency of raw material. We usually use a rimmed steel for cold heading slugs because the surface is so much more free of seams. Now from the top of the first ingot

poured to the bottom of the last, there is a drastic difference in composition. As a matter of fact, from one coil to the next, there is only one thing that you can be sure of and that is that it's different.

* * *

Now the deflection of any press is in proportion to the resistance of the load. If you put in a harder slug one time and a softer slug the next the relation of punch to die, the bottom thickness of your part will vary consequently in direct proportion. It is better to have uniformly bad material than to have some good and some bad.

* * *

The slugs are then degreased. Conventional degreasing equipment is used. The main purpose of this operation is to get oils and greases off the slugs before heat treating. The residuals of these oils and greases could be baked on the surface of the slug so hard that they would be very difficult to remove before bonderizing.

* * *

There are two reasons for annealing. The first reason being that from the previous cold work done on the slug, so much cold work has been performed that further working is impractical. The other reason is that the softer the slug the better the tool life on extrusion tools. It is for this reason that we feel the best anneal possible is the cheapest. We use a Lee Wilson bell type furnace, such as is commonly used in steel mills for annealing strip and wire.

* * *

We use a long cycle not only for softness but for uniformity. Again I want to stress that uniformity of Rockwell hardness is absolutely important in order to hold dimensions properly in the extrusion operation.

* * *

After annealing, the billets are bonderized in the same way as the rod was treated previously. The billets are then extruded in conventional mechanical presses.

* * *

The presses we use are mainly mechanical, crank, or eccentric shaft types. We prefer mechanicals because they are faster. Hydraulics are better when a long work stroke is required. The main feature that differentiates our presses from an ordinary press shop is their rigidity: high tonnages with small bed areas.

* * *

The main thing to stress in dies is the same as for presses, namely rigidity. The steels we use on our punches and dies vary. There is no one steel best for every job. We actually use water hardening, oil hardening, and air hardening tool steels, high speed steels and tungsten carbide, all depending on the individual job on hand. The different types of extrusion possible and the tool used to accomplish this, are topics in themselves about which volumes can be written and are beyond the scope of this talk, but if there are any questions, I would be glad to answer them at the close of this talk.

* * *

Many parts due to their configuration, are extruded two or more times. After each severe working, it is advisable to reanneal and recoat. For those configurations that are not possible to incorporate in the extrusion operation, the parts are then put on secondary machines such as drilling, tapping, thread rolling, etc.

* * *

Now as this talk is given before a group of people primarily concerned with wire, I'd like to dwell on our wire problems a little.

* * *

The four most troublesome items we encounter with our raw material, listed in order of importance are:

* * *

1. **Non uniformity (between different coils of material)**
2. **Surface seams**
3. **Non uniform pattern (within same coil)**
4. **Pipe**

* * *

The non-uniformity we overcome by keeping each coil of wire, or billets or parts made therefrom, entirely separate throughout the entire process in our plant. As mentioned before, due to the radical difference in composition of a coil of wire made from the top of the first ingot poured from a given heat, to the bottom of the last ingot, we get a tremendous dimensional difference in extrusion. Therefore, each coil must be separated and individually adjusted for in the extrusion operation.

* * *

The second item of seams is obvious in any upsetting operation and I need not dwell upon it to the discomfort of many persons here. I will say, though, that the average quality of material we receive today is much better than even only five years ago, but it still can stand improvement.

* * *

The third item of non-uniform pattern within the same coil is a tough one. The mills tell us it can't be, and the header operator says, "What am I making all these adjustments for." We have proven the problem does exist. The difficulty it causes is in lopsided billets not being concentric about the central axis. The extrusion operation cannot correct this and the result is eccentric finished parts and diminished life on extrusion tools.

* * *

Killed steel would eliminate this problem, but accentuate the second problem of seams. Seeing that seams are the greater problem, we live with rimmed steel.

* * *

The fourth problem of pipe, like the second, is obvious.

* * *

These are our primary wire problems, but again, headway is being made.

* * *

There will be great strides made in cold extrusion in the years to come. As better tool steels are developed for tools and better quality of production steels are made available, better coatings are developed, etc., it will become possible to cold extrude many things which seem farfetched today. Cold extrusion is, as yet, an art and not an exact science.

* * *

We are not at all certain of what is possible and impossible, but of one thing we are certain, and that is, in the years to come cold extrusion will become as well known as other production methods, such as forging, cold heading, and the other large segments of the metalworking industry.

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The Challenge of Spent Acid

by John E. Kinney

Sanitary Engineering Consultant

Ann Arbor, Michigan

This paper was presented at the Annual Convention of The Wire Association on November 16, 1960, at Chicago, Illinois.

Mr. Kinney is a licensed professional engineer specializing in water supply and waste treatment problems, principally for industry. He received under graduate sanitary engineering training at Manhattan College and received his Masters Degree from Cornell University. Prior to becoming a consultant, he spent five years with the Ohio River Valley Water Sanitation Commission, four years with the Navy, and three years with Morris Knowles, a consulting firm in Pittsburgh, on industrial waste matters.

Regeneration of spent pickle liquor to form new acid has been a challenge to the steel industry for decades. The alternatives have been to develop a method of treatment of spent acid, if one could be found at a reasonable cost, or to develop methods of cleaning steel that do not utilize acid.

* * *

The principal incentive to answer these challenges is the requirement to abate pollution. This requirement reflects the continually increasing pressure of state and federal legislation for clean streams.

* * *

That this pressure will continue to increase is not doubted. The question is whether the control program will be directed towards accomplishing water quality objectives in the stream or merely towards controls on acid discharge.

* * *

Why treat spent acid? What are the harmful effects of its discharge to a stream? Are there methods available to control acid discharges so as to overcome these harmful effects? Do the control programs consider degrees of treatment of acid wastes as they do for sewage or other industrial wastes?

* * *

These questions are pertinent to any understanding of a waste control program. The answers can do much to guide a company in the development of an effective program.

Federal Control

There are now a number of anti-pollution bills pending in Congress. Increased federal control means increase in regulations. But does it necessarily mean increased protection and full utilization of our water resources?

* * *

President Eisenhower vetoed the Blatnik Bill (H.R. 3610) on February 22, 1960, with the statement that, "Because water pollution is a uniquely local blight, primary responsibility for solving the problem lies not with the Federal government but rather must be assumed and exercised, as it has been, by State and local governments." His words underscore the need to evaluate any pollution problem on a local area basis. But solution on a local area basis means local industry and state agency teamwork to define causes, effects and degree of treatment required.

* * *

Unless that local area team develops and produces intelligent recommendations and action, the clamor for federal control will again be heard. It should be noted that many who argue for federal control are motivated by the ridiculous idea that such a control program will be paid for by the federal government and thus will not cost the local taxpayer anything. Thus socialized pollution abatement takes its place with other federal grant programs.

* * *

The farther away from the scene the control program is, the more regulations are used as a substitute for definition of the problem and objectives. As an example, a state that looks at a small pickling waste discharge—say 1500 gallons a day—in terms of the effect on a river with a flow of 200 million gallons a day will state that a trickle discharge to the river (1 gallon per minute) will be acceptable since there will be no deleterious effect. A state that ignores stream flows and conditions and announces that no strong spent acid can be discharged to a river will require haulage or treatment of the waste.

* * *

For a federal agency to recommend trickling as an effective discharge for some companies would require local area representation and study. This means a heavily staffed agency or reliance on the state agencies whose inadequacies have been used to justify the federal agency. Economy measures will limit the federal staff. The answer would be a regulation that prohibits spent acid.

Effects of Acid Discharges

Regulations on acid discharges have been adopted by many governmental agencies. The regulations vary from prohibitions on any discharge to a limitation on the effect in a stream, sewer, or treatment plant. The reasonableness of any regulation must be judged in terms of its ability to accomplish an objective without unnecessary expenditure of money and effort.

* * *

At first consideration the objective might be taken as pollution abatement. But pollution abatement in itself has as an objective the development of the public welfare. So the basis for evaluation of this regulation must be its ability to promote the public welfare.

* * *

Obviously the discharge of acid to a stream must be capable of direct or potential damage to a stream or there would be no basis for any regulation. The potential

damage lies in

1. the development of color in the stream;
2. the tendency of acid to lower the pH of a stream;
3. a reduction of the basic buffering capacity of the river;
4. an increase in iron salts in a river; and
5. the possible flocculation of the iron salts, if in sufficient concentration, and resultant precipitation of solids.

* * *

These effects vary with the volume and strength of the acid solution discharged and the volume and quality of the flow in the river.

* * *

If the pH of the stream drops below 5 there is a deleterious effect on the water used for industrial purposes. Water at lower pH is corrosive. Industries that pump large volumes of untreated water for cooling purposes thus have a maintenance cost. Where industries provide treatment of their water supply, such acid conditions require chemical addition for neutralization. This increases the solids in the water supply and causes line clogging, another maintenance cost.

* * *

Low pH also creates an interference to aquatic life and sudden changes in pH, even within the acceptable pH range (6 to 8.5), can do heavy damage to aquatic life. The effect is important, even in areas where industrial usage is the prime use of the stream and fishing is not a consideration. It is still necessary to preserve the growth of organisms that maintain stream purification processes.

* * *

In any given stream there is a range in the concentration of individual or total dissolved solids that acts as a stabilizer of the pH and influences the characteristics of the water. This buffering capacity, or basicity of the water, will react with acid discharged to the river and the resultant salts will reduce the basicity of the river water. A drastic reduction or depletion of this basicity can affect the aquatic life balance.

* * *

Then there is the effect of ferrous iron in discharges to a river. This iron may cause a color effect, with variation in color related to the amount of ferrous or ferric iron present. Ferrous iron in streams of proper pH will oxidize to ferric iron and be apparent with a change in color. In some instances color is the only basis for complaint.

* * *

Ferrous and ferric iron in proper concentration will also flocculate and form a gelatinous precipitate that will settle in streams. The concentration of iron that will cause flocculation varies, so no fixed figure can be used. Variation is due to several causes, including the dissolved solids concentration.

* * *

There are also claims that the oxidation of ferrous iron in a stream depletes the dissolved oxygen supply. This area of claim needs more definition because stream studies have failed to support the computed depletion.

* * *

Iron salts, as well as salts of aluminum and other metals, can hydrolyze in streams to form acids. However, the degree of hydrolysis and its resultant effect depend on the stream characteristics. There are those who argue that all potential hydrolysis effects of a waste must be measured and considered as damaging to a stream, and regulated as an acid discharge. The measurement is made by boiling a sample and measuring acidity by titrating to a high pH (8.3).

* * *

Whether this acid load will ever be realized in the stream is doubtful. The procedure permits no measurement of stream effect but does provide special interest groups with a tool to argue their purposes. It is one more evidence of procedures that serve special interests but divert attention from what should be the objective of these control programs—development of the public welfare.

Control of Acid Discharges

With an understanding of the potential causes of damage to a stream from a discharge of spent acid, there is basis to evaluate prohibitions on discharges or controls on discharges as well as to evaluate the effectiveness of methods for treatment of wastes. Both regulatory controls and plant discharge controls should be directed towards reasonable stream usage.

* * *

When the requirement is stated as a prohibition, that there shall be no discharge of spent acid to a stream, it rests on the thesis that the legitimate uses of a stream do not include the ultimate discharge of wastes. Such requirements do not stipulate the stream conditions that are to be maintained.

* * *

When a requirement limits the amount of acid in rinse waters to some percentage of acid purchased, there is no assurance that the stream quality will be maintained. If the limit is 15% of acid purchased, two conditions can vary drastically—stream flow and weekly production—and leave no basis to anticipate stream conditions. Yet the law is obeyed. When the stream is not protected, the criticism is directed towards the industry as a polluter instead of towards the agency setting the limit. The theoretical basis for calculating the limit of the acid carried in the rinse water leaves much room for argument.

* * *

Batch dumping of a spent acid solution of 5000 gallons can have a pronounced effect on a river. It can cause a sudden drop in the pH of the river, use up all of the basic salts in the river so that an acid condition results, cause iron flocculation, and create a pronounced color effect. As a slug it may move some distance downstream with devastating effect before dilution and dispersion reduce its harmful characteristics.

* * *

The same volume of spent acid discharged to the river at a controlled rate over a 24-hour period (3.5 gallons per minute) would not cause the same drop in pH nor depletion of basic salts, and if the concentration of iron is low enough there would be no flocculation.

* * *

Discharge of acid at 3.5 gallons per minute to a river via a sewer carrying a large volume of dilution water would further reduce the polluting effect, since there

would be more effective dispersion in the stream.

* * *

Thus it is that a recognition of the polluting effects of a waste can suggest means of overcoming some if not all ill effects.

* * *

Whether or not the controlled discharge is adequate to protect the stream will be answered by stream survey work. For many discharges the adequacy will be demonstrated. When inadequate, this control at least minimizes the bad effects.

* * *

The requirements for treatment of sewage and other organic wastes are stated in terms of a percentage reduction of solids and oxygen-consuming material (BOD). For metal-bearing wastes there is usually a limiting concentration of individual metallic ions permitted in a plant effluent or in the stream. Thus it seems inconsistent to find controls on acid in terms of a prohibition of strong acid discharges (in any amount) and limiting acid in rinse waters to a percentage of acid purchased.

* * *

Any evaluation should also consider the resultant effect on the stream of the proposed method of treatment of acid. For example, neutralization of acid with lime prior to discharge will provide protection against drop in pH and depletion of basic salts in a stream. Settling after neutralization will drop the iron salts. But the resulting discharge will carry a high concentration of calcium or magnesium salts that can increase the hardness of the river water. As an example, an arsenal above a metropolitan city water supply had a large waste acid discharge. Neutralization with lime prior to discharge would have increased the cost of softening the city water supply several hundred dollars a day. A regulated discharge to the river with dispersion of the discharge permitted neutralization of the acid by the basic salts present in the river, and thus did not affect the operation or cost of the water plant.

Acid Treatment Considerations

The treatment methods may be grouped as follows:

1. **Regeneration of acid from the iron salts.**
2. **Separation of iron salts to recover the remaining acid.**
3. **Neutralization of the remaining acid and precipitation of the iron salts.**
4. **Controlled discharge.**

* * *

In addition, control agencies recognize that a decrease in acid discharges, whether by a change in technique of pickling, better controls on leakage and other losses, or conversion to a dry cleaning operation, is a credit in abating pollution.

* * *

Thus, where steam provides the heat and agitation for a pickling bath, a change to a heat exchanger and agitation by mechanical means or by recirculation can effect a reduction in acid consumption and in acid loss to the stream. This can be very important when the bath is operated one turn a day but kept hot 24 hours a day. The new approach removes the need to draw down the tank prior to the start of the day's operation. This drawdown wastes acid.

* * *

The objections to this approach are principally on grounds of convenience. Steam condensate helps to dilute ferrous iron concentration and a daily drawdown lets the tank run longer before dumping is required. More frequent dumping means interruption to the pickling schedule, since it takes time to clean the tank, refill it, and heat the tank so that pickling can be done. But these objections can be answered by recognition that the wastage of acid is a continuing expense, the size of treatment facilities to handle the extra volume and the cost of such operation are increased, and a separate heated water storage tank would provide hot water for filling the tank so that there would be no delay in pickling. Where acid is hauled to a place of disposal, the cost of haulage of the extra volume is important.

* * *

Regardless of the method of treatment chosen by a company, good management demands that every consideration be given to reducing costs and to maintaining quality control. Reducing costs means minimizing wastage and acid consumption. This affects first costs and continuing costs of operation. The requirement to maintain quality control is increasing in importance. With evidence that pickling influences smudging and white rusting there is a necessity to develop better controls on pickling measurement than are now available. Such controls will permit anticipating poor pickling and do away with emergency dumping of solutions.

* * *

Cost of acid treatment is a variable. Efforts to reduce it to unit volume for general use require many assumptions. Each individual installation demands individual consideration. There are instances where spent acid storage is provided by a company and an outside agency hauls it away at no cost to the company. In other instances provision of collection facilities alone is a major expense. Haulage is an additional expense and may be as high as 3 cents a gallon.

* * *

Some major acid recovery proposals show estimated operating costs of 0.7 cent per gallon for a plant to handle 100,000 gallons a day but over 5 times that cost if the plant handles only 30,000 gallons a day. The initial investment is 2-3 million dollars.

* * *

These costs argue for attention to minimizing acid losses and to exploring all possible means of accomplishing the desired objective.

* * *

For companies located in cities there is a parallel problem in considering acid treatment requirements. Some cities have ordinances that prohibit the discharge of pickling solutions to a sewer, whether neutralized or not. Haulage to a point of disposal outside city limits may mean long distances. City officials and consulting engineers are reluctant to agree that a logical place for disposal of spent acid is the sewage treatment plant. The amount of acid that can be handled at any given plant must be determined by study, but more cities should learn, as Dearborn, Michigan, did, that spent acid can replace expensive iron conditioning

(*Pletse turn to page* 1588)

Moisture Control in Plastics Preceding Extrusion For Wire and Cable

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This paper was presented on November 15, 1960, at the Annual Convention of The Wire Association in Chicago, Illinois.

A little moisture in plastics goes a long way, sometimes too long a way. In the communication field we are interested in the extrusion of plastics as insulation and sheath. Questions are often asked about the effect of moisture in these operations and what steps may be taken to control it. This paper is based upon a background of polyethylene sheathing experience but it is to be expected that the principles may be applied to other materials in this field. A sudden appearance of such defects as rough sheath, homogeneous lumps, pockmarks, blisters and possibly other defects markedly limit production. This discussion considers reasons for moisture adsorption, means of moisture determination, tolerable limits of moisture in a material, and temporary and permanent corrective measures.

* * *

Is it possible that there is moisture in this compact, waxy material? Analyses show that black sheathing compound usually has a moisture content between .04 per cent and .10 per cent by weight. Surely, such a small amount cannot do any harm when it is considered that a dried insulating material such as paper contains 10 to 20 times as much moisture. That small amount of moisture, however, is very troublesome. Perhaps it is not so strange when we bear in mind that the melt temperatures probably lie in the region of 400° F to 500° F and that the pressures along the extruder barrel have been found to run as high as 5,000 psi.[1]

* * *

During normal operation, the moisture in polyethylene is due to two causes — condensation resulting from a low material temperature and hygroscopic regain. In the first case, if polyethylene is stored outdoors in a silo or car and attains a temperature of 20° F after which it is brought into a manufacturing area at 80° F and 10 per cent relative humidity, moisture condensation will occur on the material. As far as the second reason is concerned, moisture in the material reaches an equilibrium value when exposed for a period of time to a fixed temperature and relative humidity. These equilibrium values vary inversely with the room tem-

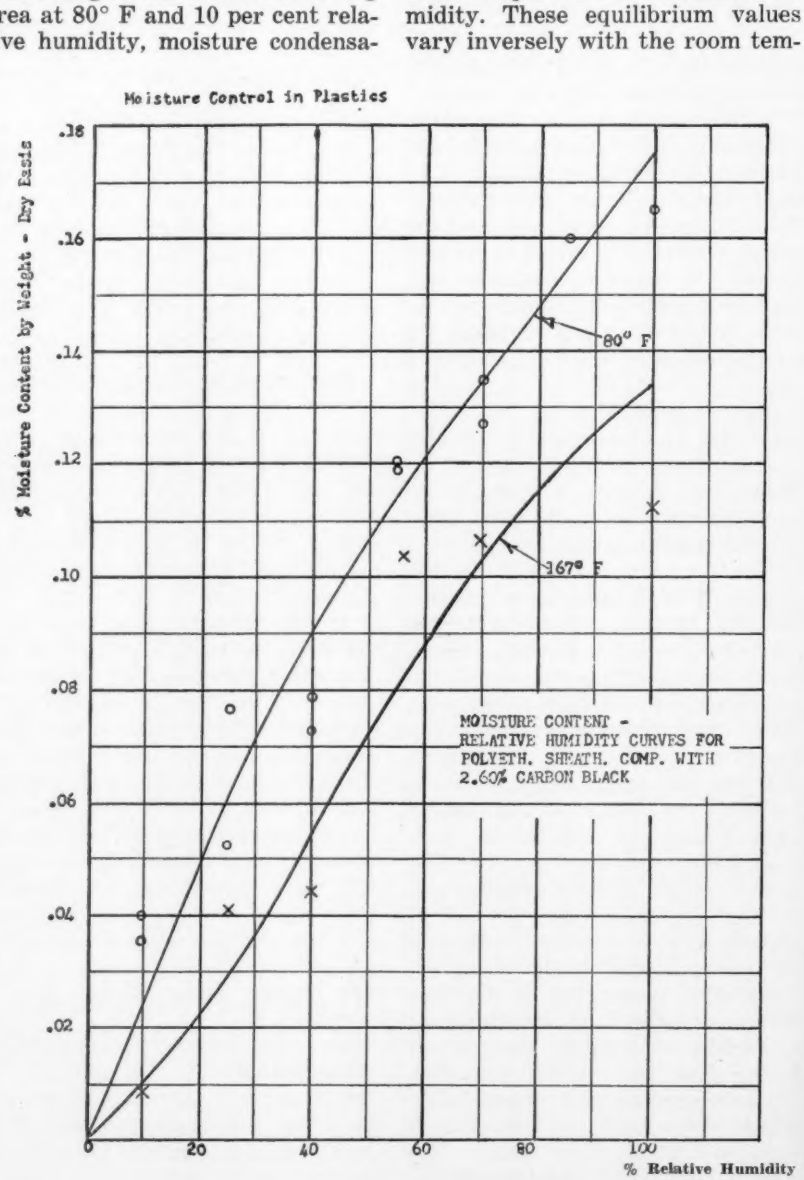

Fig. 1 —

perature for the same material. Also, they vary from material to material. It is helpful to know the equilibrium conditions for the thermoplastic material being investigated. Curves for such conditions are presented for black sheathing compound in Figure 1 [3] at temperatures of 80° F and 167° F. By means of these curves, one should be able to determine the equilibrium moisture content for the various storage conditions.

* * *

Some sheathing compounds contain from 2.35 to 2.85 per cent carbon black. The latter material is quite hygroscopic. For example, at 50 per cent relative humidity and 77° F a grade of material, used in the rubber trade, has a moisture content of 3.8 per cent [2] by weight. If we assume an average carbon black content of 2.6 per cent, we may calculate the moisture content at 50 per cent relative humidity and 80° F to be .099 per cent. The actual equilibrium value shown on the 80° F curve is .107 per cent. Thus it appears that the moisture content of the sheathing compound is largely due to the carbon black.

* * *

In order to correct moisture conditions which cause defects, a limit must be established for the maximum moisture content that can be tolerated. Of course, this entails the use of an accurate method of analysis. Representative samples must be obtained and steps taken to prevent the gain or loss of any moisture from them. There are a number of methods that are used for moisture determination. The method used will depend to some extent upon the material being tested. In making these analyses it must be remembered that the moisture content is very small and that the result may be affected by the moisture in the ambient air. The Chemical Laboratory at our Hawthorne Works uses the nitrogen sweep method [4] for determining the moisture content of the polyethylene sheathing compound. Generally speaking, the moisture is driven from the polyethylene sample and carried away with nitrogen after which it is absorbed in a pretitrated solution of methanol. The apparatus consists of a supply of nitrogen which passes through a phosphorous pentoxide, P_2O_5, drying tower, through a control valve and flowmeter, into a stoppered test tube containing the sample, out of the test tube into a small sealed container which is vented to the ouside. The small container is sealed with serum stoppers. Methanol titrated to match a standard color is placed in the sealed container before the test is started. The connections to the test tube and to the methanol container are made by means of hypodermic tubing. A weighed sample of approximately 20 grams of polyethylene pellets is placed in the test tube and heated for 45 minutes at 150°C. At the end of this period the sealed container is removed and the methanol again titrated to match the standard. From the data obtained, the moisture content is calculated.

* * *

The maximum moisture content which may be permitted can be obtained by taking numerous samples of material and associating them with the quality of product being produced. From such a study made on polyethylene sheath, it has been determined that the moisture content should not exceed .04 [3] per cent by weight.

* * *

When defects are discovered which are caused by excessive moisture, it is usually desirable to take temporary action to improve the condition. Sometimes a drier material can be obtained by using more recent receivals or by obtaining material shipped in containers fitted with moisture barriers. Any temporary drying procedures will depend upon the facilities available. In such equipment, the maintenance of proper temperatures is important. The temperatures shall not be high enough to permit the pellets to adhere to each other and to affect the coloring used. At Hawthorne we have opened 50 pound bags of material and exposed them in dehumidified storage rooms for at least 30 hours. Material received in 1,500 pound disposable cartons has been dried in vacuum dryers as shown in Figure 2. While this dried material is being used in the extruder, the time of exposure to the atmosphere should be held to a minimum.

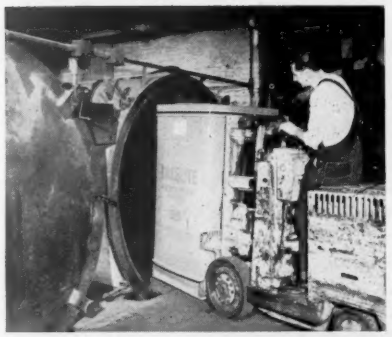

Fig. 2 — Drying polyethylene in cable core vacuum dryers. * * * * * * * *

In the permanent solution of the moisture control problem, we will briefly consider the drying process. In drying the rate is particularly important. The general relation between material temperature and time and drying rate and time are shown in Figure 3. [5]

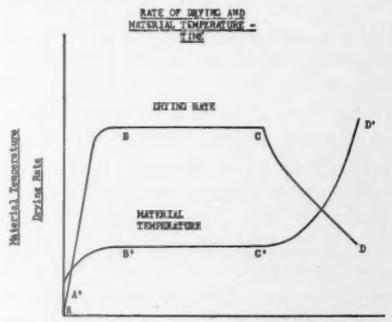

Fig. 3

From A to B the material is heating, a constant rate zone occurs from B to C, and a falling rate zone appears from C to D. The corresponding temperatures of the material are given by the curve A′B′C′D′. The factors which are affective in both drying zones will be reviewed. The air velocity is important because it affects the heat transfer coefficients and the rate at which moisture is removed from the surface of the material being dried. The exposed area influences the drying rate because it affects the rate at which heat can be transferred to the material. Also, it affects the rate of moisture removal. The total heat transferred to a material depends upon the temperature differences between the air and the surface of the material. The rate at which moisture is removed from the surface of the material is proportional to the difference in vapor pressure existing at the surface of the ma-

terial and the vapor pressure in the surrounding air. The structure of the material influences the rate at which moisture is transferred from the interior to the exterior.

* * *

The procedure used in moisture control is dependent upon the amount of plastic used. This figure usually determines the method of shipment, i.e., the use of 50 pound capacity bags, 1,500 pound capacity disposable containers, 10,000 pound capacity rubber Sealed Bins [6] or 110,000 pound capacity hopper cars. If dry plastics are furnished by the supplier, moisture regain during shipment with the latter two methods should be negligible; however, equipment must be provided at the manufacturer's plant to prevent regain there. This means that the storage system and the conveyor system, if it is of the pneumatic type, should both be supplied with air which is dry enough to prevent moisture regain beyond the tolerable value and which should prevent the condensation of moisture upon the cold plastic pellets during the winter. In the case of black sheathing compound, the air in the storage system should not have a relative humidity greater than 15 per cent at 80° F in order that the moisture regain may not exceed .04 per cent by weight. In order to prevent condensation in the winter, however, the conveying air must have a relative humidity less than 10 per cent at 80° F if it is assumed that the plastic may attain a temperature of 20° F. In order to satisfy these requirements, dehumidified air should be used.

* * *

Where plastics are received in bags and large disposable containers which permit regain during shipment, storage and use, other methods must be followed. Some of these methods of conditioning are discussed below:

Storage in Dehumidified Area
Tray and Compartment Dryers
Vacuum Dryers
Thru Circulation Dryers
Hopper Dryers
Devolatilizing Extruders

Storage in Dehumidified Area— If the storage room is dehumidified, the plastic may be conditioned by exposure for a considerable length of time. This period will depend upon the material, the moisture to be removed, the type of the container, and the humidity and temperature of the storage room. Due to a long exposure period, it may be necessary to increase the investment in the material stocked. If sheathing compound is stored, it is probably most advantageous to use a solid desiccant type of dehumidifier in order to obtain the necessary low dew point. Storage equipment of this type is usually expensive. If the extrusion area is not conditioned, the material will tend to pick up moisture during processing.

* * *

Tray and Compartment Dryers — In these dryers the load is placed in trays either supported by the dryer itself or by trucks which are pushed into it. Hot air is blown across the trays. The output of such dryers is usually low and entails additional labor to load and unload the trays. During extrusion the material dried in this manner will tend to pick up moisture from the air.

* * *

Vacuum Dryers — These dryers may be of the shelf type on which the material may be placed or they may be of the compartment type into which the containers may be positioned. Figure 2, to which we have previously referred, shows dryers of the latter type. They are usually steam heated. Although the cost of tray loading is eliminated in the compartment type, the hourly output is low. The cost of the dryers and associated pumping equipment is high. Material dried in this manner adsorbs moisture during extrusion.

* * *

Thru-Circulation Dryers — In these dryers hot air is blown through a bed or beds of material. They may be of the batch type or of the continuous type. The output of the batch type is higher than it is from the tray and compartment dryers and also from the vacuum type dryers. The continuous thru-circulation dryers give high outputs, however, they are expensive. Additional labor is required to load the trays and feed the unit. The material is subject to regain on use.

* * *

Hopper Dryers — Dryers of this design may be classified as follows:

Atmospheric Pressure Type
Drying action due to heated room air
Drying action due to dehumidified and heated air
Vacuum Type

The atmospheric pressure type of dryer consists of a hopper and a source of drying air. The hopper is mounted above the extruder feed opening. The plastic material is supplied to the top of the hopper usually by means of a conveyor. The bottom of the hopper is funnel shaped so that the pellets will feed through the unit by gravity. By means of a high pressure blower, air is introduced into the dryer in the vicinity of the funnel. Depending upon the design, the air may be recirculated or may be discharged from the system. It will be noted that no labor is required to truck to the dryer or to load the dryer. Also, the material cannot regain moisture as it passes into the extruder. In a hopper, material tends to feed more rapidly through the core than around the outside. If there are any stagnant areas, caking may occur due to local heating. It has been our experience that the temperature of the air entering the hopper should not be greater than 180° F. We have also found that if the average face velocity of the drying air exceeds 35 F.P.M. that it interferes with the gravity flow of the material and the extruder screw may be starved. In some dryers, air is supplied from heaters and in others it is supplied from desiccant type dehumidifying units. The dew point of the air leaving the latter units is 0° F or less and the temperature may be varied from 100° F to 250° F. As the heated air passes up through the hopper, it cools. When dehumidified air is used it continues to dry even though it is cool. An installation of a hopper with two dehumidifying units [7] at our Hawthorne Works is shown in Figure 4 for a 10″ extruder.

* * *

A vacuum type hopper dryer has been developed to remove vola-

(*Please turn to page* 1591)

The Cleaning of Carbon Steel Wire as Affected by the Metallurgical Nature of the Scale

by Allan B. Dove
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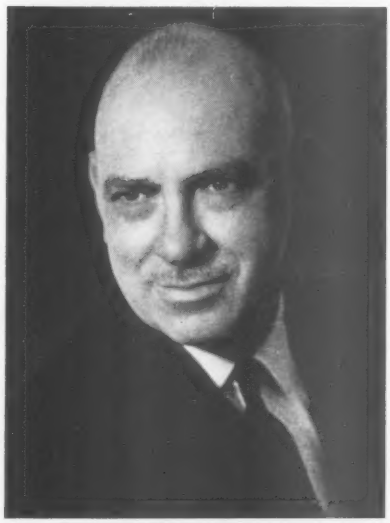
The paper reviews the theory of scale formation, effect of furnace gases and the mechanics of scale layer growth during cooling. It is shown that scale layer thicknesses, analysis and properties may be adjusted by controlled cooling to increase the speed of pickling and to reduce scale losses by as much as 65% with attendant savings. The operation of a batch rod pickling process has been reviewed in the light of $FeSO_4$ saturation values and operating temperatures to provide data which will be of value for the control of acid regenerative pickling systems. The mechanism of scale growth during patenting operations is explained, and shows, contrary to usual expectation, that the most valuable aid to rapid cleaning of patented rod is the scale-breaking operation at the takeup block due to tension rolls.

Mr. Dove presented this paper at the Buffalo Regional Technical Meeting of the American Iron and Steel Institute, through whose courtesy it is published.



Allan B. Dove

Born in Scotland, he graduated from Queens College in Kingston, Ontario, in 1932 with a degree of B.S. in Chemical Engineering. He had been employed in various wire mill departments of the Steel Company of Canada prior to attending college, following which he rejoined the company at Hamilton. In 1938 he was sent to Montreal as wire mill engineer for the company. In 1939 he joined the Royal Canadian Engineers, where he served until 1946, when he was discharged with the rank of Lieutenant-Colonel. His next Stelco assignment was that of Superintendent of the Dominion Works. In 1953 he returned to Hamilton to take charge of wire product development and in 1958 was assigned to his present post. He was President of The Wire Association in 1959 and again in 1960, is a member of the Engineering Institute of Canada, and a fellow and branch chairman of the Chemical Institute of Canada.

Introduction

Anyone who has been concerned with the pickling of steel wire rods has, at times, reached the point of complete exasperation when one type of rod has given difficulty in pickling, either by the extension of the normal period of cleaning or by the appearance of smut or black patches within the time limit when cleaning should have been accomplished. Cleaning difficulties have shown up more markedly, in the experience of pickling house operators, in heavy rods in low carbon types, while the greatest ease of cleaning is generally evident on material which has been patented, and on which the scale has been "broken" during the re-reeling operation after patenting. The problem has been further complicated by the advent of mechanical descaling, in which some of the conditions which give rise to good pickling relationships appear to have quite an adverse effect on a mechanical descaling operation. Very little has been published on the theory of descaling wire rods or on the metallurgical factors which will contribute to efficient pickling and mechanical descaling operations.

The Theory of Scale Formation

The resistance of metal to surface attack depends largely upon the type of scale formed and its physical properties, particularly those of adherence to the base metal, porosity and the tendency to crack. The type of scale depends upon its chemical properties, such as composition, density, melting and boiling points. Furthermore, the conditions during scale formation may tend to increase the thickness of oxide layers, and those formed on metallic surfaces may volatilize rapidly, may be porous, may crack intermittently, or may increase in thickness by the diffusion of the base metal outwards through the layer, or of oxygen atoms inwards through the layers.

When the specific volume of the scale is equal to, or greater than, the specific volume of the metal, a tough adherent scale is formed on a metal surface.[1] If the molecular weight of the oxide formed on a metal can be designated by M and its density by D, the volume occupied by a gram-molecular weight is $\frac{M}{D}$. Again, if m represents the metal destroyed by the formation of a specific weight of oxide and d represents its density, the volume of a gram-atomic weight is $\frac{m}{d}$. The relationship $\frac{M}{D}$ divided by $\frac{m}{d}$ determines whether the film may be considered to cover the surface. If this ratio equals 1 because the volume of the oxide has not changed in relation to the volume of the metal from which it was formed, the film may be considered to cover the surface. On the other hand, when the relationship is less

than 1 the oxide film may be stretched across the metal surface with a tension which results in cracking or crumbling of the film. If the relationship is greater than 1, the oxide layer is in compression on the metal surface and this condition may cause cracking. It should be noted that these arguments are not valid for the formation of the first microscopic layers which may have a thickness of up to about 0.0002 mm. For iron the value of the relationship Md divided by mD lies between 1.77 and 2.16. Therefore, the last condition in which the oxide layer is in compression applies to the formation of hot oxide scales on iron.

* * *

If impervious films were formed, they should protect the surface from further oxidation. But scales continue to form because, according to the theory of diffusion through films, when the radius of the metal cation is smaller than that of the oxygen ion, diffusion of the metal cation takes place through the lattice. It is characteristic of FeO that, like Cu_2O, it has slightly less metal than the oxide formulae require and this suggests that vacant spaces on the oxide lattice exist through which the metal cation moves, and electrons are free to move outward through the film, tending to prevent accumulation of electrical charge. At the surface, the electrons can react with oxygen to provide the negatively charged bivalent oxygen and allow further oxide formation. When metals have more than one valency, the higher oxides are likely to be free of metal deficiencies and thus Fe_2O_3 has more iron than the formula requires.

* * *

Fe_2O_3 is one oxide which will fail to protect the metal beneath it due to mechanical weakness. But any film of sufficient thickness may crack simply due to its different rate of expansion from that of the base, and thereby, oxygen is permitted to penetrate to the metal and carry on the oxidation of the base.

The Mechanism of Iron Oxide Film Formation

Temper colors are formed on iron at relatively low temperatures, and these are produced by interference films of Fe_2O_3 which lie directly on the metallic base. As the temperature rises up to about 575 C (1067 F), Fe_3O_4 forms as an inner layer and above this temperature an inner film of FeO forms which is stable above 575 C (1067 F). At 550 C (1022 F), the relative thickness of the layers appears to be:

FeO	85 — 90 per cent
Fe_3O_4	10 — 15 per cent
Fe_2O_3	0.5 — 2 per cent

At 1000 C (1832 F), the composition of these three oxides does not correspond exactly to that required by the chemical formulae, and all three oxides have a deficiency in oxygen content which is higher at the inner layer,[1] as shown in Table 1.

TABLE 1

Percentage of Iron in Scale at Various Positions

	Outer Interface	Inner Interface	Theoretical	
Outer layer	—	70.3%	Fe_2O_3	69.9%
Middle layer	72.35%	72.6%	Fe_3O_4	72.35%
Inner layer	75.6%	76.9%	FeO	77.75%

After a short period, the innermost portion of the scale on the iron becomes porous, and this would appear to suggest that the iron ion moves outward at a faster rate than oxidation takes place at the iron base, and therefore porosity of the inner side of the film occurs.

* * *

There are two other features which affect scale formation on iron, and these are the effect of time and the effect of temperature. It would appear that increase of time causes an increase in film thickness according to a parabolic relationship expressed by $x^2 = kt$, where x is the weight or thickness of metal consumed in scale formation, t is the time and k is a rate constant.

* * *

The second relationship of the effect of temperature appears to be that the increase in the rate of film formation can be expressed by an exponential function. In actual fact, however, this latter phase can be summarized by the simple statement that the higher temperatures tend to produce the more stable scales, while scale thickness may be considerably reduced by accelerated cooling of the rod during the hot rolling operation. As bundle weights have tended to increase, there has grown a tendency for the rod mass to cool more slowly. Again, higher temperatures have frequently been employed in the billet heating furnace as the final coil weight of rods has increased, and these factors have tended toward the production of a slow cooling, adherent scale which has increased the problems in the wire mill pickling house.

The Effect of Billet Furnace Atmospheres

Preece and Riley[2] show that the composition of the billet furnace atmosphere, especially in relation to its content of sulphur dioxide and oxygen, is an important factor in controlling the scaling properties of exposed steels. Sulphur dioxide increases the rate of scaling; it increases the tendency for breakdown of the protective film in chromium, aluminum and silicon steels, and even permits intercrystalline penetration of the scale in some degree in steels of some analyses. Oxygen in the furnace atmosphere, on the other hand, very largely counteracts the effect of sulphur dioxide and produces a less adherent type of scale. Griffiths[3] further states that the addition of steam to the atmosphere in which the steel is exposed to heat provides, under certain conditions, a readily detachable scale which leaves the underlying surface of the iron entirely free from oxide. But he brings out quite pointedly that the rate of heating to an oxidizing temperature does not have as great an effect on the type of scale formed as does the rate of cooling.

* * *

In cases of steels containing phosphorus, the oxide may penetrate around the grain boundaries, preventing detachment by bending and in a considerable degree strengthening the scale so that ultimate acid action will not readily remove it. Increasing carbon content is shown by Scheurer[4] to reduce the amount of scale formed on plain carbon nonalloy steels, while the presence of sulphur dioxide in the furnace gases can

neutralize this effect. He further shows that nickel promotes the attack on grain boundaries tending to form an adhering scale, and this effect is further increased by the presence of sulphur dioxide in the furnace gases. Chromium, on the other hand, counteracts a possible attack along the grain boundaries, while silicon promotes the formation of a heavy dense scale. Aluminum decreases the amount of scale formed, creating a protective layer against further attack. Scheurer also shows that, in general, fine-grained steels are more likely to form heavy scales than are coarse-grained steels.

Acid Attack on Scale

Normally, the only portion of the scale which is readily attacked, according to the oxidation-reduction theory of chemical reaction, is the FeO layer which constitutes the major body of the formation. In order to arrive at the FeO layer, however, we must penetrate the Fe_2O_3 and Fe_3O_4 layers. The Fe_2O_3 is normally porous, but the Fe_3O_4 constitutes a major problem of attack. Some entrapped metallic Fe can be expected within the FeO and Fe_3O_4 layers, reducing at the periphery, higher within the areas adjacent to the steel base.

Wire Mill Pickling Practice

In most cases, in wire mills, rod pickling (Fig. 1) is carried out on various types of steels which may be placed in the bath consecutively. Fig. 2 shows the increase in iron value in a 7200 Imperial gallon sulphuric acid tank maintained at an average temperature of 158 F over the greater part of the life of the tank. It will be seen that the iron value rises with a fairly straight-line characteristic until the percentage of ferrous iron reaches a value of 7, equivalent to about 20 per cent ferrous sulphate in the pickling bath, after which the iron value rises more rapidly until the bath is worked out.

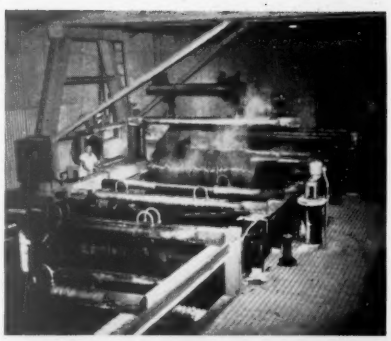


Fig. 1 — Straight line batch rod cleaning operation. 4000-pound lots of rods are cleaned in tubs in the background, and are moved through washing, liming and baking by gantry crane.

* * *

It is normal in most cleaning houses to allow the acid value to reduce in this period of rapid ferrous sulphate rise, and the reason

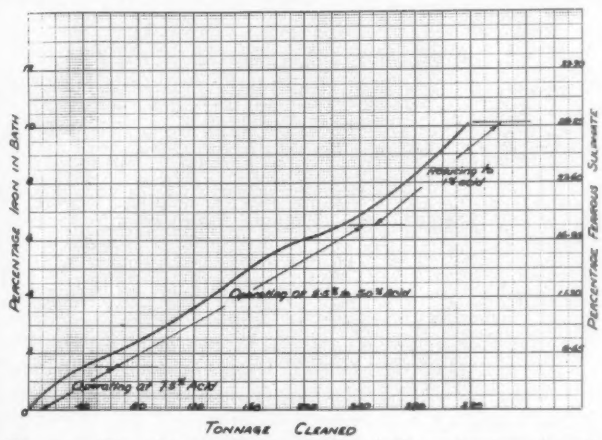


Fig. 2 — Rise of iron value in pickling bath vs. tonnage cleaned. Values shown for average plot in 7300-gallon (Imperial) pickling bath with average scale 1.96 per cent by weight. * * * *

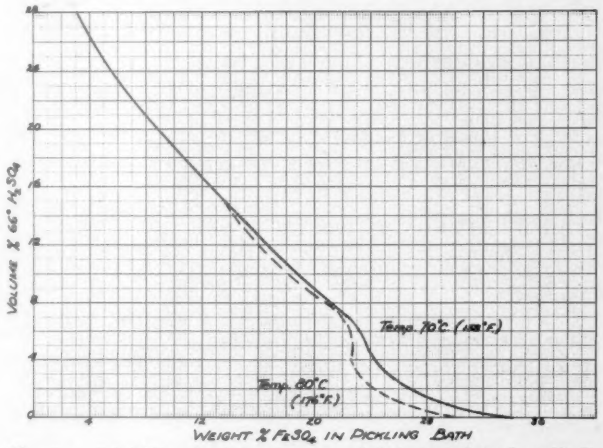


Fig. 3 — Solubility chart for ferrous sulphate in sulphuric acid. It will be noted that the solubility of the salt decreases with rising temperature and rising acid content. * * * * * *

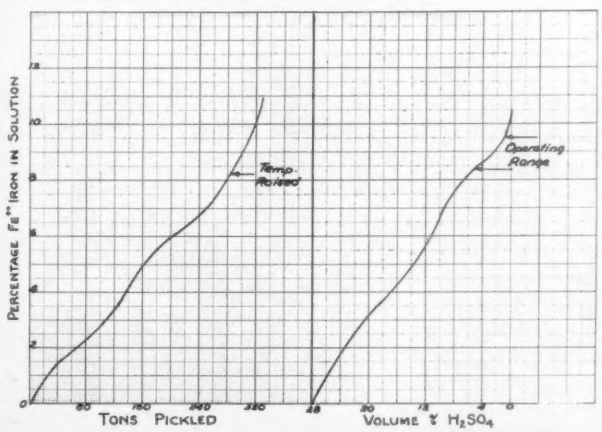


Fig. 4 — Composite of Figs. 2 and 3. This graph indicates that the bath attains saturation at 70 C at 8.4 per cent ferrous iron at 5 per cent sulphuric acid by volume. If acid values are maintained, the bath will "die." Merely increasing temperature does not prevent this situation. Acid values must be decreased to permit the bath to continue in operation. * * * * * * * *

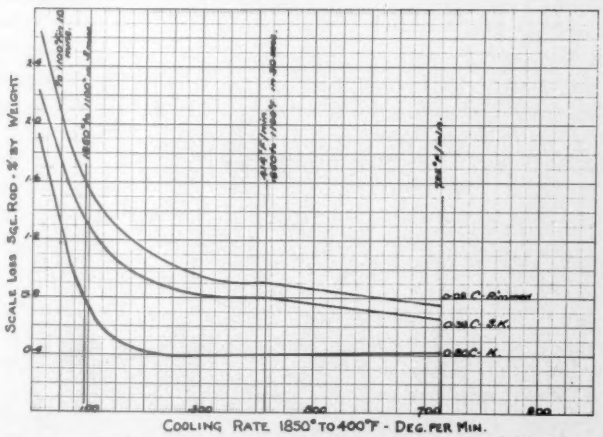


Fig. 5 — Variation of scale weight with rod cooling weight. These results for 0.08, 0.38 and 0.80 per cent carbon, 5 gage rods are from a paper by E. L. Knapp.[5] Vertical markings indicate expected scale percentages resulting from cooling from 1850 to 1100 F in 10 minutes, 3 minutes and 30 seconds. * * * * * * * *

for this will be obvious if we examine Fig. 3 in which the solubility of ferrous sulphate in sulphuric acid solutions has been plotted showing the saturation content of ferrous sulphate against volume percentages of 66 Be. sulphuric acid. If the bath were to continue to be operated at 5 per cent sulphuric acid by volume at 158 F, it would become saturated with ferrous sulphate at about 23.5 per cent $FeSO_4$ by weight. By reducing the acid percentage, however, we were able to remain just below the saturation point, and the reaction for the formation of ferrous sulphate moves to the right.

* * *

If we examine Fig. 4, we see that we finally come to a point where there is insufficient acid to continue the action and the iron value rises more rapidly until the bath is worked out at about 1 to 2 per cent acid. It is interesting to note that, at 2 per cent sulphuric acid by volume, the saturation point of ferrous sulphate in the pickling bath would occur at 27 per cent ferrous sulphate (9 per cent iron), but the bath has passed the saturation point, giving a value of 28.5 per cent ferrous sulphate (10 per cent iron) due to a short period of rise in temperature to allow the final loads to be removed in clean condition.

* * *

These graphs, then, illustrate the theoretical reason for the practical feature of lowering the acid content and raising temperature as the iron values approach saturation, and show that for iron values below 7 per cent the operation of a pickling bath may be considered to be a fairly straight-line operation with the exception of the "plateaus" which have occurred at just over 2 per cent iron and between 5 and 7 per cent iron. These "plateaus," we suggest, are probably due to an oxidation from ferrous to ferric iron which causes the action to proceed more quickly to the right and provides an apparent lowering of the rate of increase of ferrous iron in the bath.

* * *

Two further points are worthy of note. Firstly, the attack upon the steel base is reduced in acid containing ferrous sulphate. This is shown in Figs. 2 and 4, by the initial rapid rise of the iron value when less than 2 per cent $FeSO_4$ is present in the bath. Secondly, raising the temperature lowers the solubility of $FeSO_4$ in the bath, contrary to general opinion. This effect is, fortunately, overcome by increasing the rate of the acid reaction when the sulphuric acid content exceeds 1 per cent by volume.

* * *

If we are to consider acid regenerative processes, the above data provide the effective working ranges within which such processes may be successfully employed.

Scale Loss vs. Cooling Rate

To return, for a moment, to the rod cooling operation, Knapp[5] has shown, as indicated in Fig. 5, that the percentage of scale loss on 5 gage rod is a function of the average cooling rate of the rod and of the carbon content of the steel, and this is in accordance with the theory outlined above. At rates of cooling less than 48 F per minute, equivalent to cooling from 1850 to 1100 F in 10 minutes, the expected scale loss on various types of steel in 5 gage rod size would be as follows:

Low carbon, rimmed .08 C	2.6 per cent
.38 C silicon killed	2.2 per cent
.60 C killed	1.8 per cent

It has been further shown that if the average cooling rate is increased to 414 per minute, equivalent to cooling from 1850 to 1100 F in 30 seconds, these values become respectively 0.9 per cent, 0.8 per cent and 0.4 per cent. Our own studies in accelerated cooling have indicated similar values, and have shown that the weight of scale on rod is reduced by reeling at low temperatures according to Fig. 6. From these studies, we have determined that not only is the amount of scale formed a function of reeling temperature, but the cleaning time required is a direct function of the scale constitution and thickness, and therefore a direct function of reeling temperature.

* * *

If the scale weight at the rod mill is kept at minimum value by accelerated cooling, most cleaning lines may increase their output by more rapid handling and baking, rather than by more tub capacity.

Photomicrographic Studies of Scale Conditions

It would appear reasonable to assume that the more porous nature of the Fe_2O_3 layer and the amorphous nature of the FeO layer would, of themselves, assist chemical reaction in acidic solutions. Fe_3O_4, it has been pointed out, dissolves with difficulty and forms difficult-to-remove sludges. We have already indicated that because the relationship $\frac{M}{D}$ divided by $\frac{m}{d}$ is greater than 1 for iron, the oxide layer is in compression on the metal surface, and this condition may cause cracking if the compression strength of the film

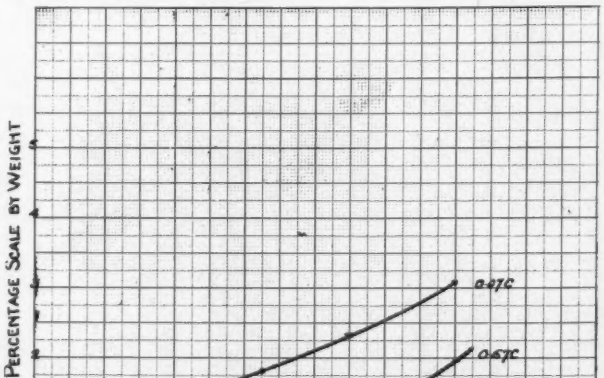


Fig. 6 — Variation of scale loss on 5 gage rod with reeling temperature. Curves are shown for 0.07 and 0.57 carbon steels. These values do not include accelerated air cooling to 1100 F. * * * *

is low. It has been shown during our experiments that difficult-to-remove scale has a complete coverage in the Fe_3O_4 layer and that those scales which may be easily removed are either cracked by their high compression values or have been broken away by bending in mechanical operation. In some plants it has been found desirable to normalize scaled steels in order to further increase the rate of growth of the FeO phase and cause cracking of the Fe_3O_4 layer.

* * *

Fe_3O_4, it will be recalled, is magnetic and — being difficult to dissolve — it may re-attach itself as a smut film to the iron after cleaning. Organic inhibitors tend to prevent this in large measure, but some commercial inhibitors which do not have a high film deposit may still permit the formation of smut on the cleaned rod, and such a contaminant will cause great difficulty in drawing operations, as well as contribute to poor finish quality. The elimination or reduction of the tendency to form Fe_3O_4 smutting can be accomplished in direct ratio to the reduction of the amount of Fe_3O_4 present, and this further, in turn, may be controlled by rapid rod cooling, by re-annealing in a reducing atmosphere or by high inhibition in the pickling operation itself.

* * *

If the smut once forms and presents a serious deterrent to drawing operations, the obvious way to remove it is to change the state of the oxide from magnetic Fe_3O_4 to nonmagnetic amorphous Fe_2O_3. This can be done by wetting the batch of rods and leaving it in the air to rust to the red oxide, or by other oxidation methods. While such conditioning will remove the smut, it does not decrease the tendency for surface roughness which can occur during the re-cleaning operation, and care is necessary when such material is handled through poorly inhibited baths. Again, some inhibitors tend to smut the surface of themselves because of the fact that they deposit a protective film, and for this reason many plants use cold uninhibited muriatic acid as a bright cleaning dip for process wire cleaning.

* * *

Two examples of difficulty in cleaning from actual case histories may well illustrate the above points.

Case 1

A type of rod imported from the United Kingdom for special purposes continually exhibited poor cleaning characteristics. When solution of the scale was finally brought about, it was accompanied by a foaming of the bath which, in some cases, was likely to cause deterioration of plant equipment apart from loss of solution. An investigation of this scale by photomicrograph showed that the Fe_3O_4 layer was almost completely unbroken around the circumference and that this impervious layer was thicker than normal, as shown in Fig. 7. Throughout the FeO mass were particles of unresolved iron which had been captured in transit, due to the fact that oxygen was cut off by the impervious Fe_3O_4 layer. It would appear probable that these iron particles were responsible for the formation of hydrogen which caused the bubbling in the bath and the foaming of the surface protective liquid.

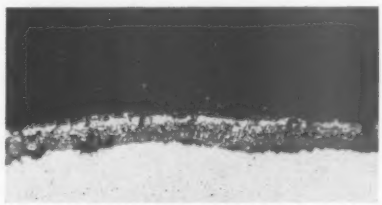


Fig. 7 — Imported rod which gave long cleaning period and foaming. The Fe_3O_4 layer is unbroken, and metallic iron is dispersed throughout the FeO area. 500X. Etched in HCl and alcohol. * * * * * * * * * *

Case 2

Two lots of .359-inch rod of the same heat of C-1006 analysis were prepared for drawing by chemical cleaning. One lot of these rods had been reeled at 1650 F at the rod mill and the other lot at 1585 F. The former lot could not be cleaned under normal conditions and required as long as 90 minutes in the cleaning tubs before scale attack could be accomplished. The second lot, reeled at 1585 F, cleaned in 40 minutes. Photomicrographs of the two structures are shown in Figs. 8 and 9. It will be seen at once that the FeO layer is thicker in the case of the 1650 F material, but that the Fe_3O_4 layer is almost completely unbroken. When reeled at 1585 F, the FeO layer is thinner than before and repeated breaks are visible in the Fe_3O_4 layer.

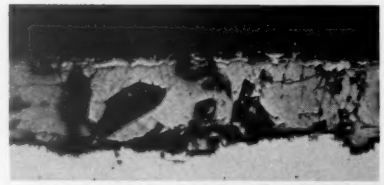


Fig. 8 — C-1006, 0.359-inch rod, cooled to 1650 F at the reels. Note impervious Fe_3O_4 layer.

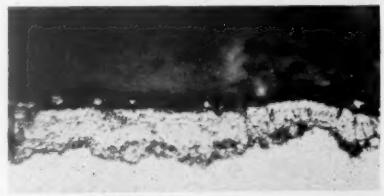


Fig. 9 — C-1006 rod, same heat as shown in Fig. 8, but cooled to 1585 F at reels. Fe_3O_4 layer is now broken to permit acid attack. FeO layer is thinner than that of Fig. 8 due to faster cooling. * * * * * * * * *

Mechanical Descaling

Mechanical descaling may be accomplished by multiplane bending to crack off the scale, or by mechanical blast cleaning as performed by the Wheelabrator type operation. One simple multiplane mechanical descaler, as shown at Fig. 10 (A) and (B), is employed as a scale remover ahead of wire drawing for wire intended for welded fabric. Typical loads of 5 gage rods were prepared by normal rod cooling, by accelerated cooling by water to 1400 F and by accelerated water cooling to 1400 F followed by air cooling. The material was then mechanically descaled and the scale was collected and weighed, with results as shown in Table 2.

* * *

It is obvious from the finish produced by such mechanical descaling that complete cleaning — of the type resulting from chemical cleaning — is not obtained. The variations between mechanical and chemical scale removal for 5 gage rod in various carbon ranges are of interest as shown in Table 3.

* * *

These values indicate that chemical descaling removes more of the scale, as would be expected, but further that cleaning by the multiplane bending process is more efficient when the rod is water and

Fig. 10 A and B — Simple, mechanical descaler. "A" shows the rolls over which the rod bends. "B" shows the rod passing directly from the descaler to the die stand on the wire drawing machine.

TABLE 2

Comparison of Scale Removed Mechanically from Rods Cooled by Various Means

Treatment	Scale Loss per ton	Scale Loss Percentage	Steel Gain per ton by Cooling
5 gage Rod C-1012 normal cooling coiled at 1530 F	25.91 lb	1.29	—
5 gage Rod C-1012 water cooled to 1400 F and air cooled for 35 seconds	12.22 lb	0.61	13.69 lb
5 gage Rod C-1012 water cooled to 1400 F	21.47 lb	1.07	4.54 lb

air cooled as in condition C.

* * *

The form of the scale cracked from the rod by mechanical descaling under various conditions of cooling is clearly different in each

TABLE 3

Comparison of Scale Removal by Chemical and Mechanical Means on C-1012

Treatment	Scale Loss Mechanical	Scale Loss Chemical	Difference
A. C-1012 normal cooling to 1530 F	1.29%	1.92%	0.63%
B. C-1012 water cooling to 1400 F	1.07%	—	—
C. C-1012 water cooling to 1400 F and air cooling	0.61%	0.66%	0.05%

case, as shown in Fig. 11. The scale cracks from the rod reeled at the higher temperature in plates. As the reeling temperature falls, and as the rod is more quickly cooled thereafter, the scale cracks off in increasing fineness and in greater percentage of the total scale present.

* * *

The microstructure of the various scales points to the development of breaks throughout the Fe_3O_4 layer at right angles to the length of the rod as the reeling temperature is reduced, and reaches its limit when the rod is rapidly cooled below the red heat. This again is in agreement with the theory of scale density and coverage stated above.

Chemical Descaling

The removal of rod mill scale by chemical means still applies, in most mills, as the principal method of cleaning. Experimental evidence based upon actual rolling and cleaning was obtained on four types of rod mill scale by repeated actual cleaning of 4000-pound lots under normal working conditions in which loads were weighed carefully before and after pickling. A typical straight-line batch cleaning system is shown in Fig. 1.

* * *

The above figures are in general agreement with the data provided in the section on Scale Loss vs. Cooling Rate, as demonstrated by Fig. 5.

* * *

It will be obvious from the foregoing Table 4 that, on a mill output of 15,000 net tons of low carbon rod there would accrue a reduction of over 200 tons of scale per month. This represents almost 121 tons of steel which can be saved at an average value of $12,100 per month. The economic advantage of reduced scale thickness will be obvious. The steel saving in pounds per ton for steel of various carbon groups is shown in Fig. 12.

TABLE 4

Comparison of Scale Weight vs. Carbon Value and Treatment

Scale Type	Scale Loss by Chemical Removal	Steel Weight Gain per ton
A. 5 gage Rope .71 — .75 C unpatented normal cooling	0.918%	—
A1. 5 gage Rope .71 — .75 C unpatented accelerated cooling	0.489%	5.06 lb
B. 5 gage Rod Spring 134/178000 psi. unpatented normal cooling	0.975%	—
B1. 5 gage Rod Spring 134/178000 psi. unpatented accelerated cooling	0.332%	7.58 lb
C. 5 gage Rod C-1035 unpatented normal cooling	1.091%	—
C1. 5 gage Rod C-1035 unpatented accelerated cooling	0.340%	8.86 lb
D. 5 gage Rod C-1008 normal cooling	1.916%	—
D1. 5 gage Rod C-1008 accelerated cooling	0.662%	14.79 lb

The Effect of Patenting On Pickling

Wire mill operators will at once select "green," as-rolled high carbon rods as one of the most difficult pickling problems facing the cleaning department, in spite of the fact that the scale is generally lower in weight percentage than that of low carbon steels when reeled at similar temperatures. We should expect that the higher carbon value induces increased reduction of the higher scales to FeO, but the fact remains that the thinner Fe_3O_4 scale is tight and generally free of breakage and such steels are difficult to clean.

* * *

Patented rods which have been heat treated at 1800 to 1900 F and quenched in air or lead are generally more readily cleaned. The effect is not actually due to the heat treating operation itself, but rather

Fig. 11 — Roll descaling of normal and accelerated cooled scales (actual size). The pile on the left results from normal cooling, coiling at 1530 F. The center pile was from rod reeled at 1400 F. The pile on the right was water cooled to 1400 F. reeled and air cooled for 35 seconds to 1100 F.

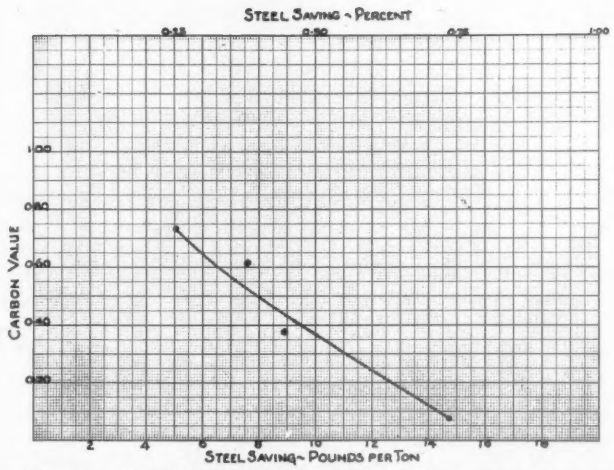


Fig. 12 — Expected direct steel saving of various carbon steels by controlled reeling temperatures and accelerated air cooling. Values are shown in pounds per ton and percentage by weight. The curved line follows actual values. * * * * * * *

to the scale cracking operation performed as the rod or wire passes over the tension rolls at the takeup. The scale breakage which occurs here consists of removal, by cracking, of the tension and compression areas as the rod is bent over the tension rolls. A thick scale still exists, however, along each side of the rod. The scale conditions at each stage are shown in the photomicrographs, Figs. 13 to 18 inclusive for C-1035 and C-1052 steels. * * *

The patenting operation is shown, in part, in Figs. 19 to 21 inclusive, commencing with the rods at the furnace exit. On leaving the patenting furnace and travelling in air, the scale grows. Fig. 20 shows the water quench arrangement. Very little scale is removed in this area, since the rod has already cooled to below 1000 F before entering the water bath. The cracked scale is seen at the reel position where it has fallen from the tension rolls as the rod passes to the block. * * *

Two examples of the effect of patenting upon scale are shown in Figs. 7 to 12 inclusive. In Figs. 13, 14 and 15 we have shown photomicrographs of a C-1035 steel before patenting, after patenting and after scale-breaking. Before patenting, the oxide layer has a thickness of only 0.00025 in. and is composed of approximately 40 per cent Fe_3O_4 and 60 per cent FeO. Immediately after leaving the patenting furnace (Fig. 14) the scale is 0.001 in. thick and is now composed of 80 per cent FeO and about 20

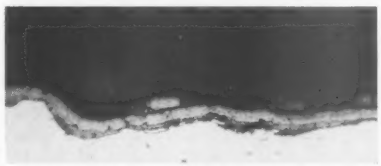


Fig. 13 — C-1035 steel. "Green" rod, as-reeled. 500X. * * * * * * * * * * *

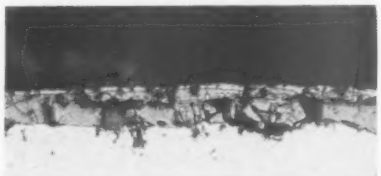


Fig. 14 — C-1035 steel. Rod of Fig. 13, after passing through furnace, before passing over tension rolls at takeup. 500X. * * * * *

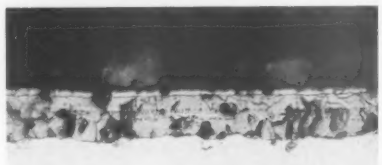


Fig. 15 — C-1035 steel. Follows Fig. 14, showing structure of neutral zone after scale-breaking. 500X. * * * * * * * * * *

per cent Fe_3O_4, and the new Fe_3O_4 layer, due to the more rapid cooling by strand operation, has only one-third the thickness of the previous layer of similar analysis. In the third photomicrograph (Fig. 15), we see that the scale, where still attached, is of the same relative thickness, repeatedly broken through the Fe_3O_4 layer and through the FeO layer where scale still exists on the periphery.

* * *

Figs. 16, 17 and 18 show a similar condition for a C-1052 rod. In this case the initial scale has a thickness of 0.001 in. as produced at the rolling mill. It consists of about

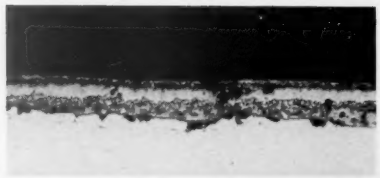


Fig. 16. C-1052 steel green rod, as-rolled, normal cooling. Note dispersed free iron, and fairly continuous Fe_3O_4 layer. 500X. * * * * *

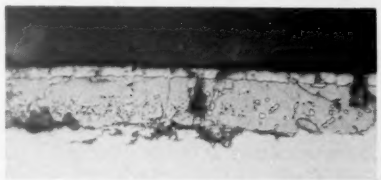


Fig. 17 — Same as Fig. 16 after passing through patenting furnace. Note growth and continuity of Fe_3O_4 layer. 500X. * * * * * * *

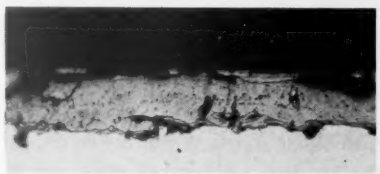


Fig. 18 — Same as Fig. 17 after patenting and scale-breaking at tension rolls. Note broken Fe_3O_4 layer in peripheral areas where scale remains at neutral zone. 500X. * * * * *

Fig. 19 — Rods leaving patenting furnace. Strands cool to black heat rapidly, usually within 10 feet of furnace for 5 gage rod. * *

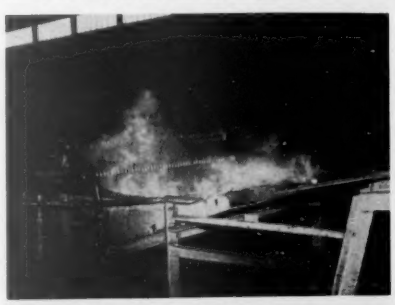


Fig. 20 — Rods after patenting at water quench. The quench cools the rod so that it will not "shrink" onto the takeup reel. This cooling also assists ease of handling. Very little scale is removed in this area. * * * * * * *

80 per cent FeO and about 20 per cent Fe_3O_4, with very little Fe_2O_3 present. The Fe_3O_4 layer is continuous, and areas of free iron are noted throughout the massive scale structure. In the second photomicrograph (Fig. 17) we see that the

Fig. 21 — Takeup reels at patenting operation. The scale is cracked as the rod passes over the tension rolls, and falls to the floor. Note piles of scales below the blocks. * * * *

scale has grown 50 per cent in thickness by patenting, and that the structure is now about 90 per cent FeO. There is less unresolved iron, but the Fe_3O_4 is still fairly continuous. In the last photomicrograph (Fig. 18), after reeling over the tensioning rolls, we have the same thickness of scale in the few areas where it still exists, but the Fe_3O_4 layer has been broken up and there are many entries through which the FeO layer may be attacked by acid solution.

* * *

Photomicrographs of the green, as-rolled rod, reeled at 1530 and 1300 F, are shown in Figs. 22 and 23 respectively. These indicate that if accelerated cooling is employed by reeling at 1300 F and air cooling according to the S-curve for the steel concerned, a new condition is brought about in which the surface scale is cracked, and the entire scale weight and thickness are reduced as shown in Table 5. Such scale will grow once more during patenting and the greater part will be removed by tension rolls as before.

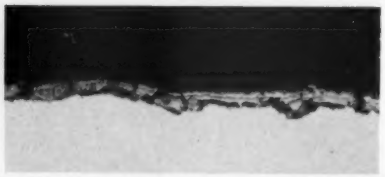


Fig. 22 — Tire wire rod, 0.77C, water cooled to 1300 F, reeled and air cooled. Fe_3O_4 layer is cracked, permitting entry to lower oxides. Thickness less than half that of normal cooling. 500X.

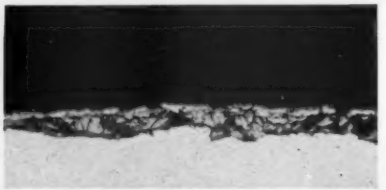


Fig. 23 — Tire wire rod, 0.77C, normal reeling at 1530 F. Fe_3O_4 layer thicker and more continuous than in Fig. 22. 500X. * * * * *

The points which have been observed from this portion of the study are:

TABLE 5

Comparison of Scale Loss on Green, Patented and Controlled Cooled Rod

Quality:	Tire Rod				
Analysis:	C.	P.	S.	Mn.	Type
	0.77	0.017	0.034	0.90	KHS

Condition	Rod Reeling Temperature	Forced Air cooled	Scale Loss	Average Time to Clean	Condition of Pickling
Green — as rolled	1530 F	No	1.25%	50.4 mins.	12.8% acid 2.4% Fe
Patented — air cooled	1530 F	No	0.22%	30.1 mins.	10.0% acid 2.3% Fe
Controlled cooling	1300 F	Yes	0.20%	15.5 mins.	11.0% acid 4.3% Fe

(a) **High carbon rods, as rolled, when reeled at 1530 F, are difficult to clean due to an impervious scale surface of Fe_3O_4 which is tight and free of surface cracks.**

(b) **Similar rods, when patented after rolling and reeling at 1530 F, grow further scale body during patenting. The greater part of the scale is removed by cracking during reereeling at the patenting furnace takeup. While the scale weight is low, it is thick where not removed by tension and compression forces induced by tension rolls.**

(c) **If such rods are cooled by water and air, and reeled in the rod mill at 1300 F, the scale weight is similar to that of patented rods, but uniformly distributed and cracked throughout. Scale removal is readily accomplished in about half the time required for patented rods.**

(d) **It would be desirable to lower reeling temperatures even on rods which are to be patented. This would reduce the scale thickness on the "uncracked" areas and still provide a saving in reducing steel loss by conversion to original scale.**

Summary

1. By a review of the theory of scale formation, insofar as it concerns wire rods, we have shown that under normal conditions the surface scale produced by heating at the billet furnace, rolling, reeling and cooling is normally in compression.

* * *

2. We have indicated, by reference to the literature, the mechanism by which scale forms and the relationships between changes of time and temperature, showing that time increases the film thickness according to a parabolic relationship, while the effect of temperature is exponential.

* * *

3. References have been given from literature which show the effects of atmospheres and analysis upon scale formation.

* * *

4. A consideration has been made of the rates of solubility of the various scales and we have shown that difficult-to-clean material frequently possesses these characteristics because the Fe_3O_4 layer is relatively insoluble in sulphuric acid, and it is not possible for the acid to reach the soluble FeO layer readily.

* * *

5. We have considered the characteristics of the rise of iron value in an actual pickling bath and have verified the conclusion that $FeSO_4$ has an inhibitory effect upon the attack of the steel base and that the conditions under which a bath must be emptied are a function of saturation of the solution with $FeSO_4$; the lowering of acid concentration at workout is necessary in order to achieve maximum solubility. We have also indicated that this data will provide an operating procedure for regenerative control of batch pickling systems and could be extended to the control of continuous systems.

* * *

6. The results of experiments on accelerated cooled rods have indicated a feasible method of reducing scale thickness and increasing yield at the rod mill with attendant savings.

* * *

7. The scale constitution principle has been used to explain the formation of smut or "carbon" on cleaned rods.

* * *

8. The effect of low reeling temperatures on simple mechanical descalers has been indicated, and typical cases of rod cleaning difficulties have been reviewed and explained.

* * *

9. We have indicated that mechanical descaling is less efficient than chemical, but that the efficiency of mechanical descaling may be improved by lowering the reeling temperature at the rod mill and by subsequent accelerated cooling to black heat by air or water.

* * *

10. We have studied the effect of patenting upon the pickling operation and have shown that, contrary to general expectation, the thickness of the patented scale is greater than that of the "as rolled" scale, even under normal reeling conditions without accelerated cooling. We have reviewed the scale formation which results from patenting

(*Please turn to page* 1589)

THE ELECTRIC WIRE & CABLE SECTION
of
THE WIRE ASSOCIATION

The committee, appointed by the Association's Board of Directors, the Electric Wire and Cable Management Committee, extends to all persons interested in and concerned with the production of insulated wire and cable a cordial invitation to join with them in promoting the progress of this branch of the wire industry. This Management Committee presently is comprised of:

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The committee arranges for papers for regional meetings and the Annual Convention, reviews them to see that they are desirable as to subject matter and quality, and formulates policies that will promote the best interests of insulated wire production personnel. Recent authorization to increase the membership to twenty-five will be implemented by further appointments in the near future.

You are invited to send for a booklet describing the activities of The Wire Association and a membership application card.

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Wire Kinks

In this department will be published helpful hints on how to do things and the questions asked by our readers on wire processing problems, together with the answers and comments thereon received from the field. In no instance will the identity of the persons asking for advice or of those supplying it be published.

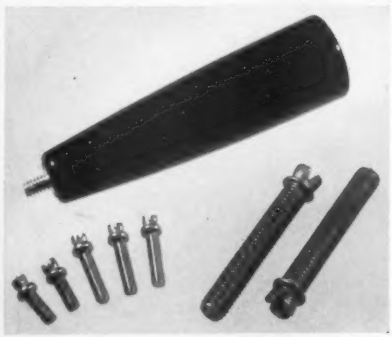
Our readers are invited to send helpful contributions and to submit questions on their technical problems to the Editor. These will be answered from information on hand or from the field, when it becomes necessary to secure counsel from that source.

Stainless Steel Solves Special Cold Heading Problem

A 50 percent increase in the production of special cold headed inserts has been achieved by C. S. M. Screw Products Co., Chicago, by the selection of a suitable grade of stainless steels, from which the inserts are made.

* * *

The newly developed product, an insert with a split head collar of stainless steel, is molded into a plastic handle with threaded end extended.



Split head collar insert for plastic handles.

Initially, the insert was made from carbon steel and brass. Then it was produced from a stainless steel for high strength. The original stainless grade, however, caused premature galling of dies and non-uniform parts.

* * *

Tests of other grades resulted in the selection of Carpenter Stainless No. 10 and Type 430 stainless grades, which solved the production problem. They now are cold headed at the rate of 5,000 to 6,000 pieces per hour, double the previous rate.

* * *

The manufacturer of the inserts attributes its smooth production runs to the uniform copper coating on the cold heading wire and to the mechanical properties of the steels themselves.

* * *

The stainless No. 10 alloy is a modified austenitic 18-8 chrome-nickel steel that is particularly useful for cold headed and upset parts because it work-hardens more slowly than any of the conventional 18-8 analyses. It has been found useful for cold headed parts that must remain non-magnetic after severe cold working. Type 430 stainless is also extremely ductile and suitable for the mass production of cold headed parts.

* * *

This insert, molded to the plastic, greatly increases the holding power and strength of the finished fastener. The fastener is used for non-slip handles on electrical appliances.

Glycerine Use in Electroplating

Technical Literature and recently issued U. S. patents indicate that glycerine's role in the metals field is firmly established.

* * *

The method for electrodepositing molybdenum on ferrous and metal surfaces (U. S. 2,943,029) uses a bath consisting essentially of glycerine, alkali hydroxide and molybdenum oxide, the hydroxide and molybdenum oxide each comprising between 1% and 12% by weight of the glycerine.

* * *

U. S. Patent 2,931,758 describes a method for simultaneously electrodepositing indium and gallium in a specially-formulated electrolyte made of a halide of trivalent indium, a halide of trivalent gallium, a conductivity enhancing salt, and glycerine as the organic solvent.

* * *

Another patent (U. S. 2,900,313) cites glycerine's use as a component as an addition agent for increasing the operating speed of plating baths. Ammonium molybdate, in a concentration of one to three ounces per gallon, is mixed with one to two ounces per gallon of glycerine, and a current density in the range of 80 to 225 amperes per square feet of cathode is passed through the solution.

* * *

Recent reports on Russian plating work (Chemical Abstracts, 54,-12,11755) also deal with the addition of glycerine to the electrolyte in electroplating light copper from sulphuric acid baths, and its effect in electroplating zinc from sulphate electrolytes.

Lubricant for BX Cable Strip

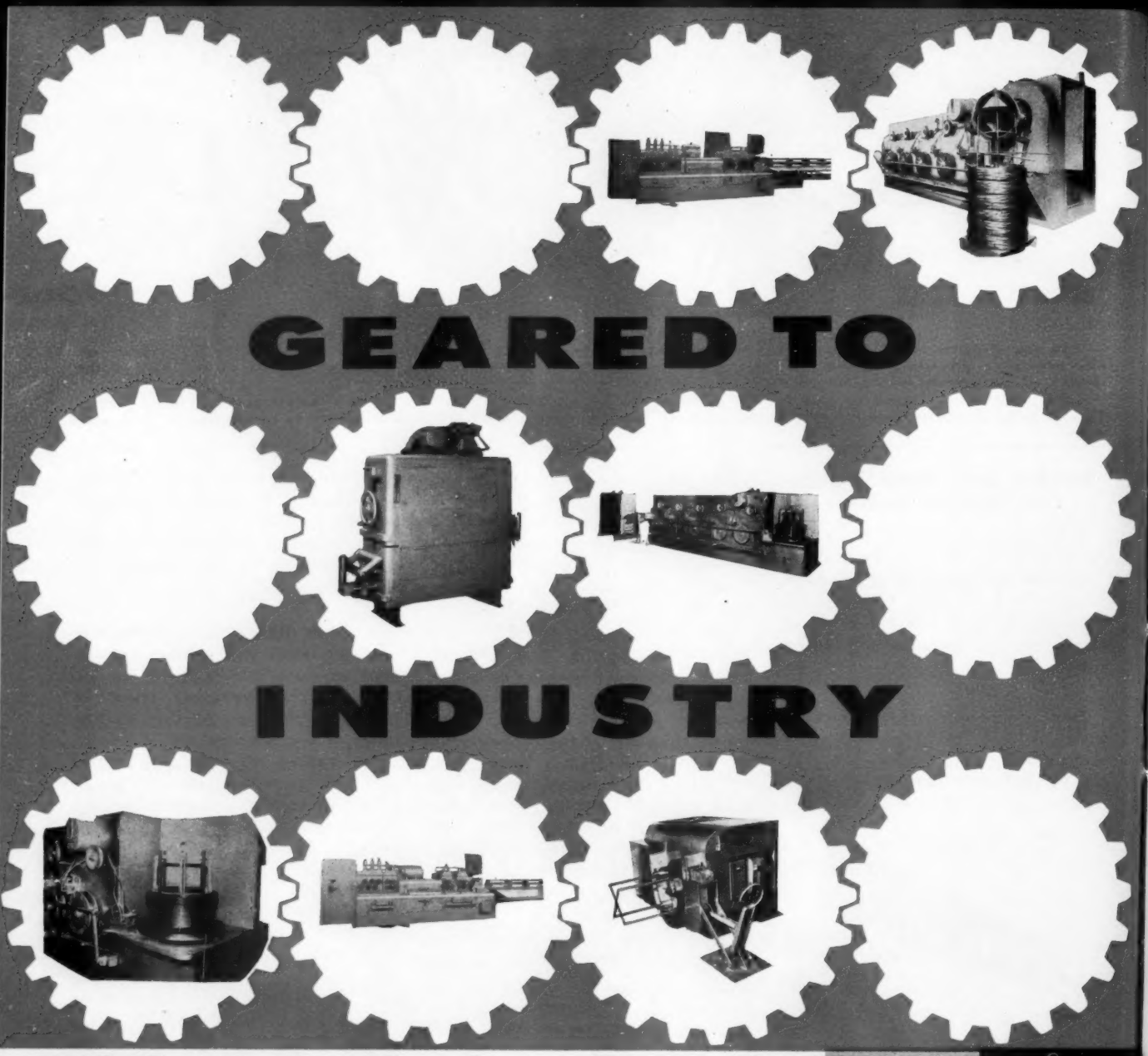
Lubricating BX cable stock prior to the cladding or winding operation involves some requirements that would seem impossible to meet. The lubricant must withstand the tremendous pressure exerted on the strip; the galvanizing must not be removed by the pressure and friction, and when the finished cable leaves the cladding machine and arrives at the inspection station, it must be dry.

* * *

That was the problem of a wire and cable plant about three years ago.

* * *

Their complaints about the lub-



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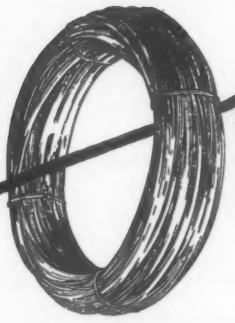
Wire Kinks



ricant they were using at that time were that it turned rancid in a short time, stained the cable with black greasy deposits which accumulated on the machine, and it frequently separated without warning and lost its lubricating qualities. After many tests, the formula settled on, and still in use, is one part Oakite 12 to six parts water. This lubricant is made up in a trough through which the strip passes on its way to the cladding machine. Tests indicate that the galvanizing is unharmed. Finished cable passes the 300-pound pull test. Very little heat is generated. By the time the 250-ft. coils leave the machine and arrive at inspection, no trace of lubricant remains.

Courtesy of Oakite News Service

Thermoplastic Uses Growing

Hot rodders are now using ignition wires covered with transparent thermoplastic insulation, clear, or in brilliant colors.

* * *

In addition to its sparkling appearance this insulation offers excellent dielectric protection, is readily handled, and its smooth surface is easily cleaned by wiping. Also the thermoplastic is compounded to be self-extinguishing so that while the insulation may melt it will not burn.

* * *

This is just one instance of the increase in the use of thermoplastics dring the past decade. Wiring harnesses which supply power for the many accessories on today's cars, controls for outboard motors, cords for lamps and small appliances, building wire, and connections for electronic equipment all use large quantities of plastic insulations.

* * *

A major reason for the change to plastics is the variety of colors available. Bright and of uniform shade, the wires will not fade or discolor because of age, heat, or sunlight. Using a group of wires of different colors provides ready circuit identification and, for special purposes, parallel or diagonal stripes in contrasting colors may be specified.

* * *

By a proper choice of plastic, wires are produced to withstand continuously temperatures up to 105°C.; a modification in compounding will permit the insulation to retain low temperature flexibility. The thermoplastic materials may be soft or semi-rigid and if greater abrasion resistance is required this may be provided for in the compounding. No outer braid or lacquer coating is necessary and the surface of the wires is dry, tough, and smooth.

* * *

Specified originally by some manufacturers because of its lower cost, thermoplastic insulated wire has established its position by contributing quality and reliability in a wide range of applications.

Courtesy of Autolite Engineering Letter

Brass Plating of Stainless Wire

Manufacture of stainless steel wire with electroplated brass finish has been achieved successfully by National-Standard Co.

* * *

The plated brass finish, said not to have been available before on stainless wire, combines the adhesion of brass to rubber with the corrosion resistance of stainless.

* * *

Stainless has been very difficult to plate with brass, particularly stainless types of wire that must flex in service. This process also produces an adhesion between the brass plating and the stainless surface that exceeds the adhesion between the brass and rubber.

* * *

Initial applications are expected in high-pressure hose (where braided wire construction provided only mechanical protection in the past) and in timing belts (where wire reinforcement was previously impractical due to the poor adhesion qualities of stainless steel wire needed for corrosion protection).

* * *

This new electro-plated stainless wire is supplied on all common types of stainless, ranging from 0.007 in. to 0.103 in. diameter. The wire, put up in dessicated drums, is furnished in coils or on spools according to customer wishes. The new wire is priced approximately 10% above ordinary stainless, the prices depending upon wire size.

Polishing Panel Pins

QUESTION

We are manufacturers in India of wire product, making nails, panel pins, shoe tacks, etc.

* * *

We have been having difficulty in securing a good shine on panel pins when polishing them with sawdust. Can you suggest a better polishing medium?

ANSWER

Sawdust is not considered to be too effective a polishing agent and most concerns desiring to secure a fine finish on products like panel pins use what is called "mazo" in their tumbling barrels.

(*Please turn to page* 1589)

Outmoded Tax Laws Imperil Creation of Jobs

America's job-creating economic growth is being stunted by outmoded tax depreciation laws that critically hamper U. S. industry in replacing one-third of its machines considered technologically obsolete, a survey disclosed July 31.

* * *

The survey by the American Economic Foundation covered the opinions of 33 leading business and industrial organizations and companies which presented testimony before the 1960 House Ways and Means Committee hearing on depreciation policies.

* * *

The principal conclusions of these business and industrial leaders were:

(1) Unless the tax depreciation laws are liberalized to give incentive to industry for investment in new machines, the United States economy will fail to grow fast enough to insure our prosperity and to meet the challenge by the Soviet Union for world industrial leadership.

(2) Present tax allowances do not take into account the twin problems of obsolescence and inflation which make it increasingly difficult for industry to acquire capital for replacement.

(3) The United States — burdened by $90 billion worth of aging and inefficient industrial tools — will continue to lose markets abroad and at home to foreign competitors who enjoy the double advantage of low pay-scales and greater tax write-offs to modernize their plants.

* * *

The statements made before the House Committee — which all agreed that reform was vitally necessary — probably indicate the results of the government's own survey which would show overwhelming support for liberalized depreciation changes.

Translations Available

The following translations may be secured from the British Iron & Steel Industry Translation Service, The Iron & Steel Institute, 4 Grosvenor Gardens, London, S.W. 1, England. Prices follow each item.

1609 Investigation of the quality of continuously cast steel ingots
N. A. NIKOLAEV
pp. 49-61. (£6 10s. od.)
This reviews factors which determine the quality of the continuously cast product and discusses the optimum shape of casting (comparing rounds, squares, ovals and slabs). (Abstract J.I.S.I., 1958, June, p. 180c.)

1610 Design of the continuous casting plant at Novo Tula
V. P. DRUZHININ
pp. 62-66. (£2 15s. od.)
The author gives details of the vertical continuous casting machine at Novo Tula (south of Moscow) for producing 24 in. by 8 in. slabs at speeds of up to 7 ft. per minute. Conditions for obtaining good surface and structure are outlined. (Abstract J.I.S.I., 1958, June, p. 180c.)

1611 Investigation of the quality of continuously cast steel
N. L. KOMANDIN
pp. 73-83. (£5 15s. od.)
The mechanical properties of continuously cast billets after normal degrees of hot working are discussed. Small cracks are completely welded up during hot working, even with small reductions. Cracks appear to be the result of very high stresses in the billet during the last stage of solidification. This can be remedied by careful control of withdrawal and water consumption for secondary cooling. (Abstract J.I.S.I., 1958, June, p. 180c.)

1613 Basic factors affecting the technology of continuous steel casting with a moving mould
I. YA. GRANAT
pp. 145-155. (£5 15s. od.)
Deals with the mathematics of the movement of the solidification front for various shapes of products, the strength of the casting shell, the formation of the axial zone and the question of mould wall thickness. (Abstract J.I.S.I., 1958, June, p. 181a.)

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1614 Peculiarities (and defects) of the formation of billets produced by continuous casting
O. D. ZIGEL
pp. 164-177. (£5 15s. od.)

1616 An investigation of the mechanical properties of steel during solidification.
An analysis of the process of the formation of hot cracks during continuous casting
L. M. POSTNOV and B. B. GULYAEV
pp. 212-222. (£6 os. od.)
The effect of carbon content on hot workability is discussed, especially in relation to hot cracking. The properties of the solidified shell of the continuous casting and the effect of stresses is discussed. (Abstract J.I.S.I., 1958, June, p. 181b.)

1618 On planning scientific investigations on the continuous casting process
A. M. SAMARIN
pp. 267-270. (£2 15s. od.)
Many of the problems which will have to be solved before continuous casting becomes commercial are touched on. These include mould design, protection against oxidation, a complete study of the properties of liquid metal and automation of the process. The necessity for carefully co-ordinating research is stressed. (Abstract J.I.S.I., 1958, June, p. 181b.)

1657 Reducing segregation in rimming steel. 1 — Blowing oxygen into ingots
SHAO HSIANG-HAU and PANG YUEH-CHU
Acta Met. Sinica, 1958, (2), pp. 98-109. (£9)

1689 Graphical method for determining forces and power requirements in drawing bars and tubes
H. MAKELT
Industrie-Anzeiger, 1959, May 19, pp. 28-31. (£3 os. od.)
The graphical method described permits a ready calculation of data in respect of forces and power requirements both for simple and multiple drawing processes. These data are sufficiently accurate for practical purposes and have been confirmed by experiments on draw benches. (Author's summary.)

1586 Surface roughness of hot-worked and cold-drawn steel tubes:
I. Basic considerations, influencing factors and definitions;
II. Development of surface quality in hot working (Ehrhardt process);
III. Development of surface quality in cold plastic shaping.
H. MUHLENWEG
Stahl u. Eisen, 1959, Nov. 26, pp. 1792-1800 (I, II); Dec. 10, pp. 1844-1852 (III). (£10 os. od.)
I. Connection between plastic shaping processes and surface changes. Methods, criteria and equipment for the measurement of roughness. Surface formation in free and in confined shaping. Influence of sliding characteristics. II. Hot shaping by the Ehrhardt process. Influence of individual operations in the process on the development of the inside and outside surfaces of the tube. Mutual influences of tool and workpiece on the surfaces. III. Development of outside and inside surface in cold shaping. Influence of reduction in diameter, wall thickness, die angle and initial surface in sinking, plug drawing and mandrel drawing. Surface change in the case of several passes without intermediate annealing. Influence of annealing and pickling and of different separating layers and lubricants. Concluding remarks. (Author's summary.)

1658 Effect of low temperatures on the strength of eleven plain carbon steels (up to 0.12%C) under biaxial stressing
A. KRISCH
Arch. Eisenhut., 1960, Jan.., pp. 19-24. (£3 15s. od.)
Tensile and internal pressure tests on specimens of eleven plain carbon steels (up to 0.12%C) in the normalized and aged condition at room temperature, —30°C and —70°C. Comparison of data on the yield strength and tensile strength with strain energy hypothesis. (Author's summary.)

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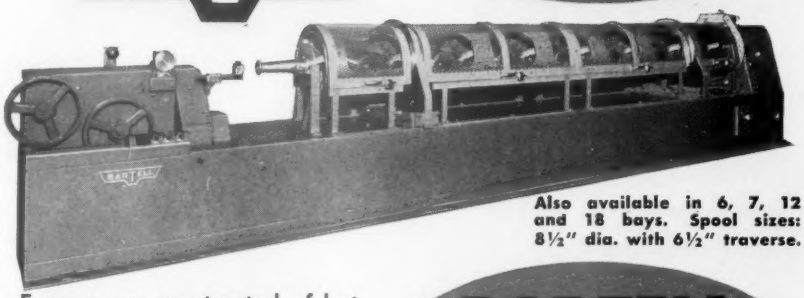

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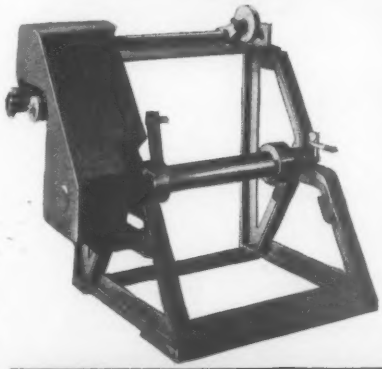

This Take-Up is belt-driven, the drive originating from a slip clutch located outside the capstan box. Electrically operated traverse adjustable from zero to maximum reel width. Accommodates reels up to 30" dia. Speed selector sheave adjusts lay on reel to suit diameter of finished strand.

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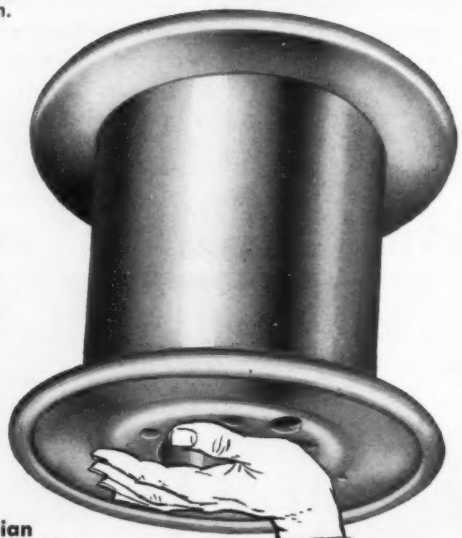

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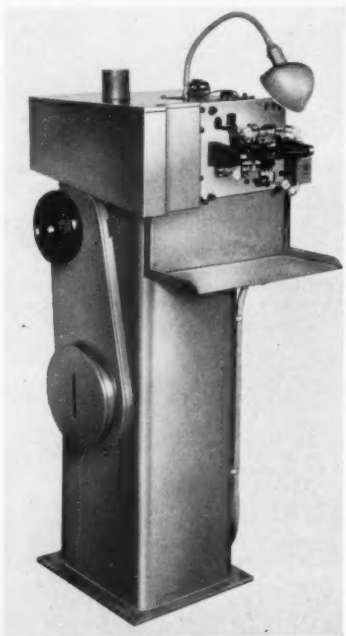
New Spring Machine Announced by Baird

The Baird Machine Co., Stratford, Conn. has announced a new spring coiler, the "Baird Spring Generator," that offers new cost-saving opportunities in the production of springs, clips, clamps, coils and other products from wire in the .008" to .034" range.

* * *

Standard spring coilers form springs only, with loops having to be made as a separate operation. The Baird Spring Generator forms the springs and loops in one continuous operation on each end of the spring. These loops may be varied, by simple adjustments, so that closed, open, extended hooks, etc., may be produced.



Baird Spring Generator

* * *

Production rates, because of a variable speed drive, will run from 720 to 6400 pieces per hour. The machine weighs 420 pounds and occupies a floor space (less wire supply reel) of only 22" x 27". Special tooling can be acquired on order. Full details can be secured from The Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.

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An engineer can't carry in his head all the information he has ever learned, but he can carry in his pocket all the information crammed into the **"Engineer's Vest-Pocket Book."**

* * *

Whether you are looking for the formula for the Binomial Theorem, the properties of structual steel, the strength of gear teeth, the properties of saturated and superheated steam, the resistance of immersed body moving through fluid, thermal stress, resistance, veniers, cost estimating, properties of minerals, chemical solubility, or any of the other 250 **main** items and 47 **important** charts, you will find the information in the 192 pages of this handy ($2\frac{5}{8}$ x $5\frac{1}{2}$) book.

* * *

There is an alphabetical index, an index of charts and tables, as well as 12 marginal indexed headings: Mathematics, Building, Mechanics, Heat, Hydraulics, Pipes, Electricity, Surveying, Costing, Mining, Chemistry, and Miscellaneous. Everything has been done to make it easy for you to find what you need.

* * *

Copies may be purchased from **Oppenheimer Publishers, Inc.,** 4805 Nelson Ave., Baltimore 15, Md., for $.90 each.

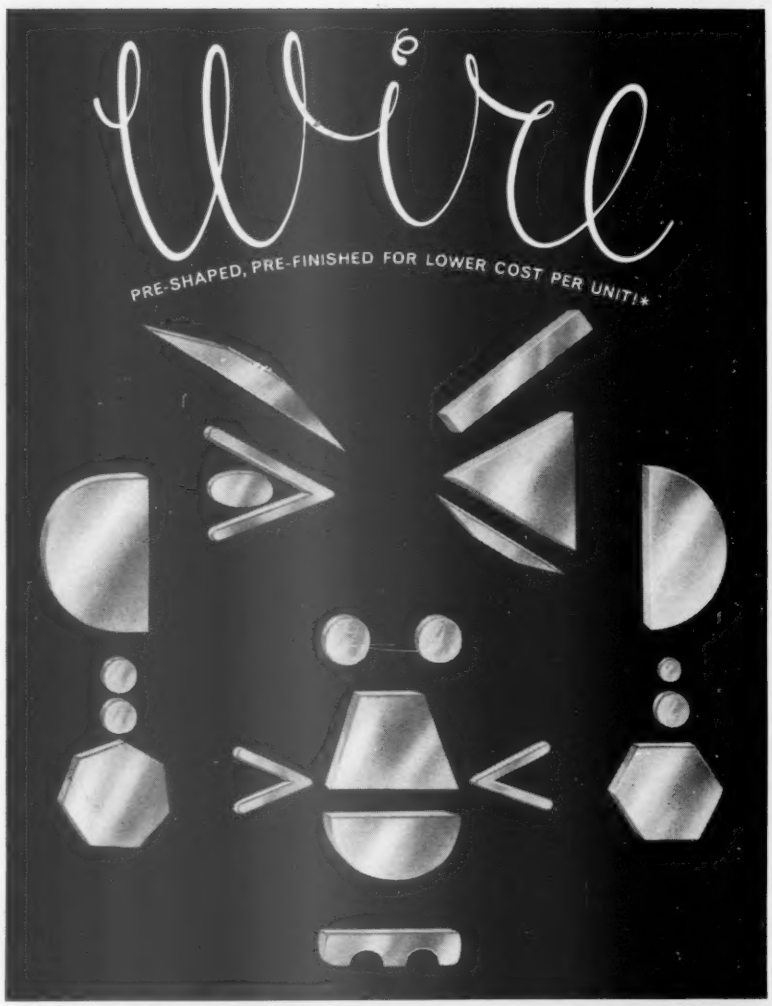
New Roller-Gliding Overhead Track Switches

The Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has just put into production two new overhead track switches designated as Types K and L. Designed for loads of 2000 lbs. to 4000 lbs. capacity, the switches have features that aid safety, ease of operation and ensure long life.

* * *

They are of rugged construction, assembled in jigs to assure accuracy and permanency of alignment, and to minimize the failures due to repeated shock loads, vibration and twisting strains that are normal.

* * *



*Examples shown are greatly enlarged cross-sectional views of selected standard and special shapes available

The right shape plus the right finish equals lower production costs

with CONTINENTAL® round and special shaped wire

Face up to the pleasant fact that you can often shave your production costs appreciably—and win extra sales—by choosing the right shape in wire. You save because you eliminate forging, stamping, rolling or machining operations. What's more, you can get these ready-made shapes (and many others than shown) in bright, galvanized, coppered, liquored, or tinned finishes that save further in polishing and plating. If you use low and medium low carbon steel wire in any shape, form or finish, by all means learn what Continental can offer you. We have solved literally thousands of problems involving wire. We'd love to have a shot at solving yours.

Write for free copy of our new wire manual

CONTINENTAL STEEL CORPORATION KOKOMO, INDIANA

PRODUCERS OF: Manufacturer's Wire in many sizes, tempers, and finishes, including Galvanized, KOKOTE, Flame Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright and special shaped wire. Also Welded Wire Reinforcing and Galvanized Fabric, Nails, Continental Chain Link Fence, and other products.

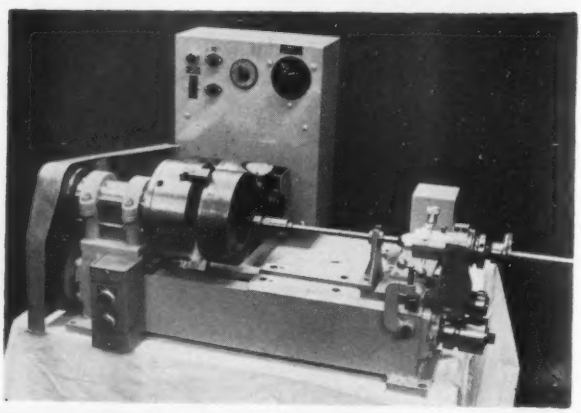
LOOK!

what they're doing in the

DIE ROOM NOW!

NEW DYKREX

DIE SERVICING & FINISHING MACHINE
FOR REFINISHING LARGE DIES
UP TO 7½ INCH CASINGS



DYKREX Engineers

have done it again! Instead of using a Special Large Lathe, Internal Grinder and then Hand finishing LARGE Dies; NOW your Dies up to 7½" in diameter can be finished in your own Die Room with this New Dykrex Die servicing machine.

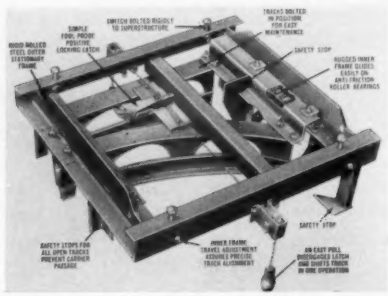
DYKREX wire die finishing machines
The Standard of the Wire Industry

DYKREX CORP. OF AMERICA

Manufacturers & Engineers

17-19 Grove Street ● **Montclair, N. J.**
(Newark Suburb)

The inner track-carrying frame rides on anti-friction rollers and a strong latch mechanism holds the switch firmly in position.



Type K Track Switch

Safety guards are provided to prevent carriers from running off open ends of incoming rails.

* * *

Types K and L Switches are made for left-hand, right-hand and three-way operation; for manually-operated and motor-propelled systems. The switches may be shifted by hand, electric or air power.

New Wire Brazing Unit

Of special interest to wire manufacturers and users of copper wire is the new electric carbon-block brazing unit for joining both solid and stranded copper wires offered by **M. G. Steele Company,** 312 North George St., Rome, N. Y.

* * *

This pedestal type unit is intended for use by the operator in a standing position. It is portable, weighing around 50 pounds. The unit makes use of 115 volt — 60 cycle current and has capacity for brazing wires from No. 30 to No. 16 A W G, either stranded or solid. It is rugged and is designed to withstand the rigors of use in the wire mill and factory. Maintenance requirements are low.

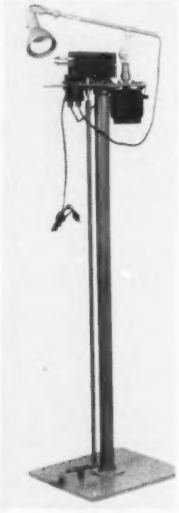
* * *

The brazer is especially adaptable to stranding, cabling or respooling operations in the copper wire mill. It is simple to operate and produces dependable joints of high tensile efficiency. The loss of electrical conductivity resulting from such brazed joints is negligible. The joints obtained from this

unit have greater strength, smaller annealed section and greatly reduced stiffened length in the case of stranded wire. Other important features of these joints are the greater accuracy of butted alignment of the wire ends and the fact that the diameter of the joint is practically the same as that of the wire itself.

* * *

The Steele brazer makes use of small silver solder pellets which are obtainable in various diameters and lengths. No flux is required in making the brazed joints. This is very important where the wire is to be later insulated with polyethylene, as any residual flux might cause environmental cracking of the insulation.



Model M-101 Steele Electric Brazer

American Brass Name Change

The American Brass Company, one of the nation's largest copper and brass mill product manufacturers, officially changed its name to **Anaconda American Brass Company** on October 3, it has been announced by company president, **Richard M. Stewart.**

* * *

"Since the end of World War II there has been a decided trend in our business toward advertising, marketing and packaging our goods under the brand name "Anaconda," and it is only common sense that we identify our brand name with our company name. Many of our products are trade-

For Fungus Resistance, Specify

TEXTILENE TWI-TAR

Offering great durability along with light weight, Textilene Twi-Tar is successfully used for buried communication cable (bedding and overall serving), expanded ACSR cable (expander between core and conductors), stationary power cable and portable cables.

Twitchell's superior Textilene line also includes: Moisture-resistant fillers — *Twi-Flex* and *Twi-Wax.* Used for non-metallic sheathed cable, maritime shipboard cable, varnished cambric cable.

Soft, dry fillers — *Twi-Port* and *Glascor** (Fiberglas-centered for high tensile strength without added bulk). Used for control, power, appliance, coaxial and communications cables, and all types of portable and flexible cords.

*Patent Applied For

For Every Wire and Cable Application
Twitchell's TEXTILENE Fillers Fill The Bill

Quality-controlled materials that are dependably uniform . . . in standard forms, or customized to special needs.

Initial low cost with savings added by production efficiency . . . flexible, ready-to-use fillers that fit all equipment, handle and form easily, always maintain desired shape.

Assured supply from a reliable domestic source . . . always available in economical and convenient packaging.

Proved performance as components of cables and wires that meet government specifications . . . stability shown by trouble-free installations in continuous service 20 years and longer.

FREE — SAMPLE SPOOLS of any type of Textilene filler to demonstrate the superiority of Twitchell materials in your operation—also technical counsel without cost or obligation. Just tell Twitchell your end-use requirements. *Write, wire, or phone today:*

E.W. TWITCHELL INC.

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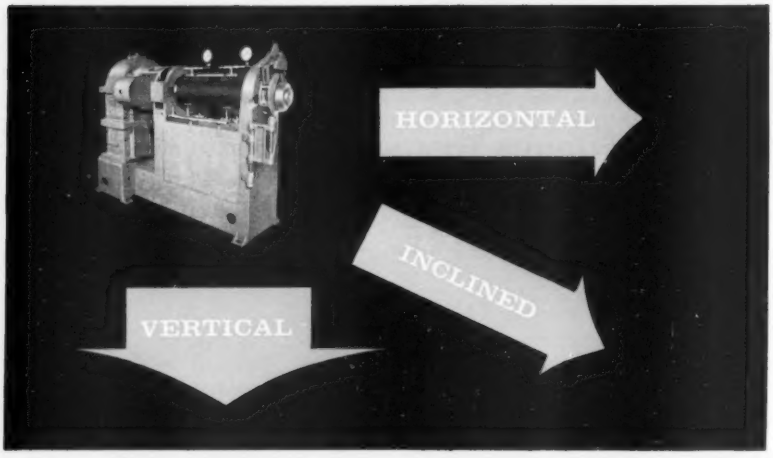
PAPER PRODUCTS FOR THE WIRE INDUSTRY

Twisted • Folded • Pressed • Crushed • Shaped • Braided • Woven

DAVIS-STANDARD
CONTINUOUS
VULCANIZING
SYSTEMS



Whatever your CV requirements — you can't afford to overlook these Davis-Standard exclusives:

- Experience — More CV systems engineered and produced than any other manufacturer of extrusion equipment (both new plant layout and integrated systems for existing plants).
- Patented Thermatic Extruders with steam/water temperature control.
- Patented Pressure Roller Feeder.
- Patented Feeder Block.
- Patented Rotative-Flo Crossheads.
- Patented Water Level Control
- The leading supplier of proven CV Systems.

Ask Davis-Standard engineers to lay out and recommend a "MATCHED COMPONENT" system for your CV line.

D-S DAVIS-STANDARD
thermatic
Division of
FRANKLIN RESEARCH AND DEVELOPMENT CORPORATION
16 WATER STREET, MYSTIC, CONNECTICUT

PRECISION EXTRUSION CONTROL IS OUR BUSINESS

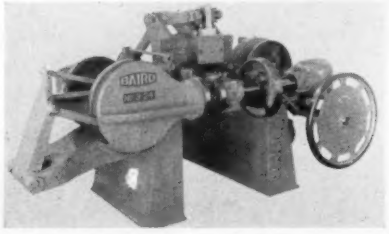
marked prominently, and we have taken the move with the expectation that our closer product identification will assist us in our marketing efforts. The name change will not affect the company's operating policies," said Mr. Stewart.

Design Change on Baird Wire Forming Machine

A new flat face form bracket has been incorporated on the Model 3-24 ribbon and wire forming machine (4-slide) manufactured by **The Baird Machine Company,** 1700 Stratford Ave., Stratford, Conn. The new feature permits the tool maker much wider latitude in tool design in providing the simplest tooling at the lowest cost.

* * *

The flat area enables the mounting of various form holders to best suit the individual tooling. Two



vertical motions with four strokes now are available and the vertical motions may be placed at the right hand and left hand ends of the tool area. The bracket mounting surface readily permits the mounting of special motions in the tooling area.

* * *

Operating speed per minute on regular work is 50-80 rpm. This speed can be increased when cams having shorter strokes are substituted for standard cams. Complete specifications on the Model 3-24 and other models can be obtained by writing The Baird Machine Co.

Get the habit of reading regularly
WIRE AND WIRE PRODUCTS
The Wire Man's Magazine

Outstanding Personalities of the Wire Industry

Carpenter Steel Names Howard Beaver Assistant General Superintendent of Plant

Howard O. Beaver has been appointed assistant general superintendent of **The Carpenter Steel Co.** plant in Reading, Pa., Manager of mill metallurgy at the plant for the past two years, he came to Carpenter in 1948 and was named plant metallurgist in 1951 and production metallurgist in 1957. He is a graduate of Pennsylvania State University with a degree in metallurgy in 1948.

Davis Standard Appoints Research Head

Norton C. Wheeler, Jr. has been appointed Research and Development Manager of **Davis-Standard, Division of Franklin Research and Development Corp.**, Mystic, Conn. Mr. Wheeler's work will be directed primarily toward the development of high-production systems for all types of plastics extrusion.

* * *

Under his direction, a completely instrumented extruder has been installed in the Davis-Standard Laboratory. From twelve vital measurement points, this unique recording instrumentation is capable of simultaneously sensing eight different pressure, temperature, and mechanical variables. With the Pressure and Temperature Totally Instrumented Extruder, Wheeler will conduct extensive studies on such factors as stock screw design leading to the development of advanced extrusion machinery.

Norton C. Wheeler, Jr.

* * *

Mr. Wheeler has been a Davis-Standard sales engineer for twelve years. He is well known in the wire and cable industry throughout the U.S. and Canada.

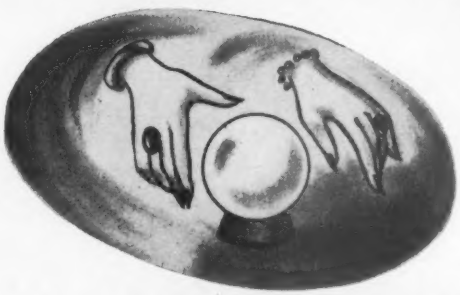
Weston Announces New Managers and District Offices

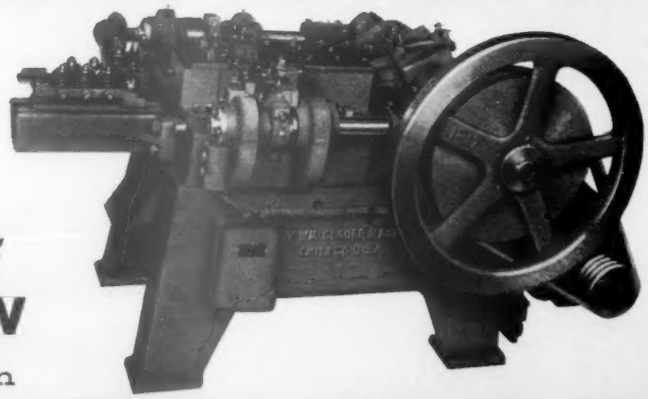
Daystrom, Incorporated, Weston Instruments Division, has announced the appointment of managers to new district and branch sales offices.

* * *

Webber I. Collart has been named manager of the new Pittsburgh district office at 875 Greentree Road, Pittsburgh 20, Pa. He was formerly a regional specialist

IF THERE'S A NAIL MACHINE IN YOUR Future make it a GLADER





11 SIZES OF MACHINES

AVAILABLE NOW

Write for 12 Page Bulletin

Wm. GLADER MACHINE WORKS 210 N. RACINE AVENUE CHICAGO 7, ILLINOIS

EXPORT DEPT. 122 EAST 42ND STREET • NEW YORK 17, N. Y.

in the Cleveland area.

* * *

Thomas C. Odderstol has been appointed manager of the Charlotte district office. The new office is located at 500 East Morehead Street, Charlotte, N. C. Mr. Odderstol previously served on the Washington, D. C., sales force.

* * *

Two new branch offices have also been created, at Phoenix, Ariz., and Grand Rapids, Mich. **Walter B. Cooper,** formerly of the Los Angeles office, is now branch manager of the Phoenix office at 221 East Camelback Road, and **J. Gordon Walker,** formerly of the Detroit district office, is branch manager for the Grand Rapids office at 2336 Eastern Avenue, S. E.

Coulter & McKenzie Promotes Lewis

The Coulter & McKenzie Machine Company announces the promotion of **Thomas E. Lewis, Jr.,** to the position of Works Manager.

Prior to his employment at Coulter & McKenzie, Mr. Lewis served in the Armed Forces as a Company Commander in the Ordnance Battalion of the Fourth Armored Division, in the European Theater, during the Second World War. Upon completion of his military service, he undertook a course of study at New Haven College which led to his being graduated with honors and the receiving of a degree in Mechanical Engineering.

Thomas E. Lewis, Jr.

* * *

Currently, he is a member of The Wire Association, The American Society of Mechanical Engineers, The American Welding Society, and a member of the faculty of the Bridgeport Engineering Institute. Mr. Lewis started employment with Coulter & McKenzie as a machine designer and progressed to Assistant Chief Engineer, Chief Engineer, Superintendent, and currently to Works Manager.

* * *

Mr. Lewis holds several patents in the Payoffpak method of handling wire which The Coulter and McKenzie Machine Company introduced to the wire trade, as well as several patents in the hot forging field.

Swindells Appointed To D-S Sales Staff

Donald Swindells has been appointed as **Davis-Standard** Sales Engineer for midwest and southwest states. He will service wire and cable insulating accounts on sales of Thermatic extruders and

Marking Machines, Wheels & Inks

FOR INSULATED WIRE, TUBING AND PIPE—

Type VDM — Illustrated has these Features:

1. Use present towers, no changes necessary.
2. One filling of ink well, gives 18 HOURS of continuous simulated spiral striping, number coding or printing.
3. For single or double marking or hash mark striping.
4. Constant wiper pressure.
5. Diam. range .032 thru 1½".

GEM GRAVURE CO., INC.
West Hanover, Massachusetts, U. S. A.
CABLE ADDRESS: GEMGRA
Telephone: ROCKLAND TRiangle 8-0456

IN THE MARKING OF EXTRUDED MATERIAL THERE ARE BIG ADVANTAGES IN ONE SINGLE SOURCE OF SUPPLY.
KNOW-HOW • INKS • WHEELS • MACHINES

West Coast Representative: Paul I. Kenner Co., 230 Shaw Rd., So. San Francisco, Calif.
West Germany: Walter G. Fritzke GMBH, AM Wehrhahn 94-96, Dusseldorf, W. Germany
Warbrick Engineering Specialties Limited, Barclays Bank Chambers, Sanky Street, Warrington, England.

accessory equipment throughout the territory and, in addition, handle general plastics extrusion business in the south central and southwest areas.

* * *

Mr. Swindells has a B.S. degree in engineering from Brown University and a Masters degree in business administration from Northeastern University. He has worked as a project engineer for Simplex Wire & Cable Co., and as a project engineer for Owens-Corning Fiberglas, Textile Product Development Laboratory.

* * *

C. J. Beringer Co., 5667 Milwaukee Ave., Chicago, will continue to service Davis-Standard plastics extrusion accounts in Illinois, Minnesota, Wisconsin, Indiana, and Michigan.

Two Men Promoted by Johnson Steel

Promotion of **George F. Walker** of 31 Eastford Road, Auburn, and **William H. Eklund** of Eight Lots Road, Sutton, was announced on September 16th at the Worcester plant of **Johnson Steel & Wire Company, Inc.**

* * *

Mr. Walker was promoted to Plant Manager from Production Superintendent, and Mr. Eklund was moved from Supervisor of Production Scheduling to Production Manager.

* * *

The promotions were announced by **John H. Greenaway**, Manager of Operations for Johnson Steel.

William H. Eklynd — George F. Walker

The jobs both are new in the Worcester plant, which manufactures high carbon steel wire. Johnson Steel, located at 53 Wiser Ave., in Worcester, also has plants in Akron, Ohio, and Los Angeles, Calif., is a subsidiary of **Pittsburgh Steel Company.**

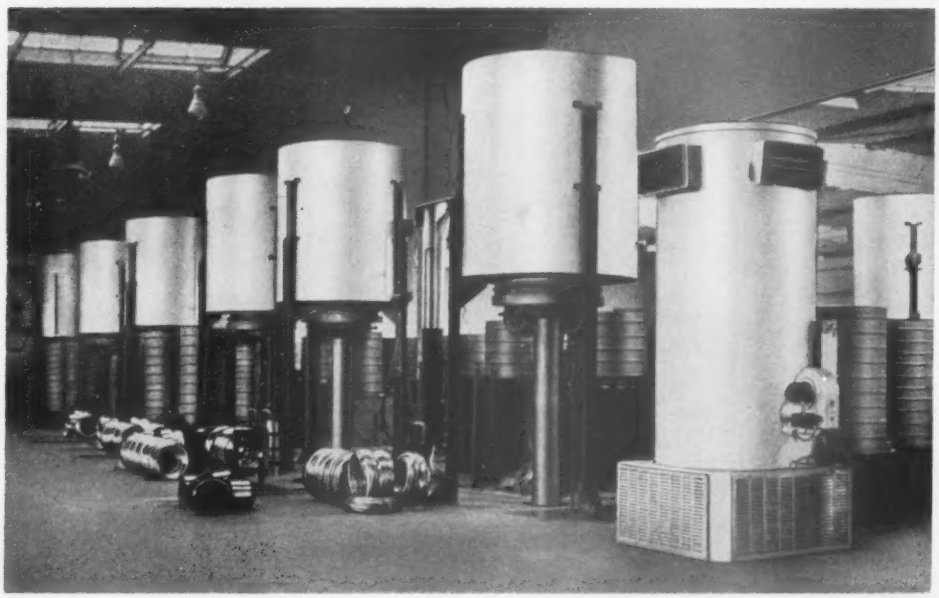
* * *

Mr. Walker will be responsible for production and maintenance at the Worcester plant. He is a graduate of Clark University and Worcester Polytechnic Institute School of Industrial Management and joined the company in 1950. Mr. Eklund will be responsible for the inspection, shipping, and receiving departments and will continue to supervise production scheduling. He also is a graduate of Clark and the W.P.I. management school. He joined Johnson Steel in 1951.

Heads Keystone's Research

The appointment of **J. B. Kopec** of Trenton, New Jersey, as Director of Research and Metallurgy

THE LAST WORD IN MODERN EFFICIENT DESIGN!



SEVERAL VACUUM BRIGHT ANNEALING UNITS WHICH WE HAVE INSTALLED IN ONE OF THE MOST PROMINENT CABLE WORKS IN GERMANY

(German and Foreign Patents)

*

SOLE REPRESENTATIVE:
PAUL REICHER
Machinery & Equipment
600 Eglington Ave., East,
Toronto 12, Ont., Canada

OFENBAU **FRITZ** G.m.b.H.&Co.K.G. **HAGEN,** (W.-GERMANY)

of **Keystone Steel & Wire Company**, Peoria, Illinois, effective September 12, has been announced by **R. E. Sommer**, President and General Manager.

* * *

In this newly created position, he will be responsible for the firm's Metallurgical Laboratories, Physical Testing, Quality Control, and Inspection Departments. In addition, he will promote and direct technical research and metallurgical advancement by providing coordinative technical assistance and guidance as required.

* * *

Mr. Kopec joins Keystone after having served in the capacity of Metallurgical Engineer, John A. Roebling's Sons Division, C. F. & I., Trenton, N. J., where he has been since 1953. There he was responsible for analysis, process control, and quality of ingots, billets and rods produced in that firm's open hearth and hot mills division.

Triangle Elects Officers

The Annual Meeting of Stockholders of **Triangle Conduit & Cable Company** was held in New Brunswick, N.J., September 23, 1960. Incumbent directors re-elected are as follows:

John E. McAuliffe, Chairman
Joseph G. Slater, Vice Chairman
Carl S. Menger
Clyde V. McKay
John E. McAuliffe, Jr.
Jack M. Slater
Schuyler Van Vechten

* * *

Following this meeting, the Directors met, resulting in the promotion of three officers: **J. G. Slater**, former President, was moved up to Vice Chairman of the Board. **C. S. Menger**, former Executive Vice President was made President, and **C. V. McKay**, former Vice President-Operations has become Executive Vice President.

Appointed Vice President of Modern Plastic Machinery

Frederick J. Maywald has been made Vice President and General Manager of **Modern Plastic Machinery Corporation**, a leading plastic extruding and blow molding equipment manufacturer in Clifton, N. J.

* * *

Mr. Maywald has had more than twenty years engineering and managerial experience in the rubber, chemical and plastics industries. His career includes association with National Rubber Machinery Corp., National Hygienic Products Co., Duratex Corp., Allied Latex Corp., Tecla Chemical Co., and Standard Latex Co.

* * *

A graduate of the RCA Radio Institute, he completed advanced studies at Massachusetts Institute of Technology, Harvard University and The American School.

* * *

At the same time the company announced three other appointments: **Bruno V. Menegus**, Chief Engineer; **Leslie J. Kovach**, vice president in charge of blow molding; and **Casper S. Gilbert**, sales manager.

the latest HIGH SPEED
TUBULAR STRANDING MACHINE
from HANSON & EDWARDS . . .

. . . for the cable and wire rope industries.

19-12½ bobbin machine, one of the new models now in production. The capstan unit, with cantilever mounted haul-off sheaves, is a complete separate unit coupled by shaft and flexible coupling to the main machine.

* External wire guides increase efficiency—reduce "down-time"—provide quick, easy threading.
* Overall dimensions reduced—increased speed.
* Electro-mechanical or electrically operated air brakes to choice.
* Rotor runs in large split roller bearings.
* Direct gear-driven capstan gives positive lays.

HANSON & EDWARDS LTD
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P5078

Carpenter Names Regional Metallurgist

The Carpenter Steel Co., Reading, Pa., manufacturer of specialty steels, has named **Ernest Joy Lane**, Wheaton, Ill., as regional metallurgist to handle technical service problems in the midwest area. He will work out of the firm's Chicago office and warehouse located at 4501 James Place, Melrose Park, Ill. Previous to his appointment, he was a Carpenter salesman for four years.

New Firm to do Custom Plastics Compounding

The formation of a new corporation, **Woodbridge Plastics, Inc.**, to provide custom compounding of vinyl and polyethylene for the wire and cable, vinyl shoe, profile extrusion and injection molding industries, was recently announced by **Kenneth B. Cary**, President, and **Richard A. Murphy**, Vice President-Sales.

* * *

Equipment presently installed in the plant at Woodbridge, N.J., includes a banbury mixer, open mills, extrusion, dicing and dry-blending facilities. Production was begun on October 1, 1960.

Kenneth B. Cary — Richard A. Murphy

ASTM Selects New Executive Secretary

Thomas A. Marshall, Jr., has been elected Executive Secretary of the **American Society for Testing Materials** by its Board of Directors, effective October 15, 1960, it has been announced by **Dr. A. Allan Bates**, President of ASTM. Mr. Marshall is currently Senior Assistant Secretary of the American Society of Mechanical Engineers.

* * *

As Executive Secretary of ASTM, Mr. Marshall will head a staff which supports a Society of 10,500 members and 6000 additional committee members. Through its organization of some 85 technical committees, ASTM devotes its efforts to the stimulation of research and to the development of standard specifications and methods of test for materials.

* * *

Fred F. Van Atta, formerly Assistant Secretary of ASTM, was elected to the post of Treasurer with responsibility for the business operations of the Society. **Robert J. Painter**, formerly Executive Secretary and Treasurer, will continue as Consultant to the Executive Secretary. He will be especially concerned with the Society's long-range planning program. **Raymond E. Hess** will continue as Associate Executive Sec-

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DURA CURL RIMS
Yes, it's the exclusive MPS heavy duty thickened-section rims that assure maximum strength and rigidity throughout the reel heads. Flange run-out and straightening expenses are eliminated by this patented MPS development. DURA-CURL rims are now standard on all MPS wire drawing, annealing, and stranding spools and reels. We invite your inquiries – let us tell you more about Dura-Curl rims.
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trouble-free winding spools and reels
Mossberg PRESSED STEEL Corporation
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No. 107

retary. As Technical Secretary and Editor-in-Chief, Mr. Hess is responsible for the technical activities and publications of the Society.

Higbee Joins NEMA as Consultant

Clarence W. Higbee, who retired recently as assistant general manager, Electrical Conductor Division, **Kaiser Aluminum and Chemical Sales, Inc.,** has been retained as a consultant by the **National Electrical Manufacturers Association** to study import problems affecting the insulated wire and cable industry.

* * *

Mr. Higbee will work directly with the NEMA Wire and Cable Division in his new capacity. A former president of the Association, he has had forty-one years' experience in the wire and cable business and is known throughout the electrical industry for his dynamic and capable leadership of various sales promotional programs. Mr. Higbee is a past chairman of the NEMA Adequate Wiring Committee and, before retiring from Kaiser, served on the NEMA Board of Governors — a position to which he had been elected regularly over a span of 19 consecutive years.

New Head of Chicago Steel & Wire

The election of **James C. Steffan** as president of the **Chicago Steel & Wire Company** has been announced by the board of directors.

* * *

Mr. Steffan, who has been with Chicago Steel & Wire since 1937 and who was Columbus district manager before becoming vice-president and sales manager in Chicago in 1952, replaces **Dana Summers,** who is retiring from the presidency and board of directors.

* * *

A native of Columbus and a graduate of Ohio State University in electrical engineering (1922), he now is completing his second term as president of the Fine and Specialty Wire Manufacturers Association. He resides in Columbus, from where he commutes to Chicago every week at 2095 Park Hill Dr., Bexley.

* * *

Another change announced by Chicago Steel & Wire is the retirement of **A. W. Nelson** as treasurer and as a vice president and director of the firm and his replacement as treasurer by **Oliver L. Bardes** of Cincinnati.

* * *

Richard F. Olin is district manager of the company, which has Columbus offices at 44 E. Broad St. Mr. Olin, who has been with the firm for 14 years, supervises sales throughout a five-state area.

* * *

Chicago Steel & Wire manufactures Super-Stitch Bookbinders' and Boxmakers' Stitching Wire, as well as other types of fine wires. The company maintains offices and jobbers throughout the United States.

Établissements

VICTOR LINÉ

of Albert (Somme) France

Originators of the famous LINÉ-GORCY Rod Descaler

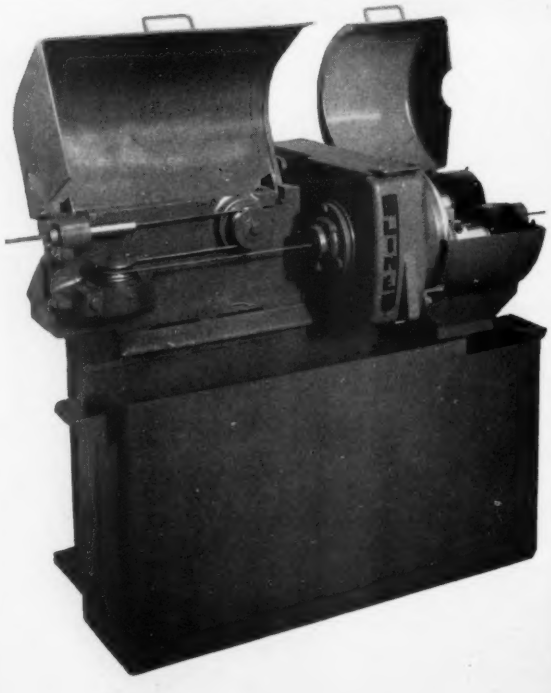
Proudly Announce Their

NEW DC-1-A & DC-2-A MECHANICAL ROD DESCALERS

FOR CLEANING HOT ROLLED WIRE RODS UP TO ⅝" DIAMETER INCL.

New Features

Lubrication of *Bearings* — permanent — sealed
Increased efficiency — Motor driven brushes
Newly designed hard-faced *Roller* units
Easier *Threading* and easier *Maintenance*



With these Superior Machines
MECHANICAL Ddescaling OF WIRE RODS
— Takes a Giant Step Forward

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122 E. 42nd St., New York 17, N. Y.

Chairman of Elgin Watch Named

Henry M. Margolis has been elected Chairman of the Board of Directors of the **Elgin National Watch Company.**

* * *

Mr. Margolis, Chairman of the Aero Supply Manufacturing Company, Inc., has been a member of the Elgin Board since 1958. The post of Chairman had not been filled since the death of **T. Albert Potter,** former President and Chairman on January 24, 1949. **George J. Daly, Jr.,** Executive Vice President and Treasurer, will continue as Chief Executive Officer.

B-L-H Appoints Engineering Manager

Baldwin-Lima-Hamilton Corporation has announced the appointment of **Leon Mollick** as Manager of Engineering, Industrial Equipment Division, Philadelphia. Mr. Mollick has been associated with the division as Chief Stress Analyst for 10 years, directing research, development and stress analysis in the U.S.A.F. Heavy Press Program and other special engineering problems involving large hydraulic equipment, pressure vessels and missile launching equipment.

Spring Firm Appoints West Coast Manager

Edward C. Spal, Sr. sales manager of **Associated Spring Corporation's Gibson Division** at Mattoon, Ill., has been appointed to succeed **Charles M. Holnback** as general manager of the firm's **Seaboard Pacific Division,** Gardena, Calif., according to an announcement by **Carlyle F. Barnes,** president. **Troy L. Sorensen,** sales supervisor at the Chicago sales offices, replaces Mr. Spal. Mr. Holnback resigned as general manager of the Seaboard Pacific Division to undertake other activities. He remains as a director of the corporation. The changes are effective October 1, 1960.

* * *

Associated Spring Corporation, with general offices in Bristol, Conn., has plants and sales offices in the leading metalworking areas of the United States and Canada, a subsidiary in Puerto Rico, and an affiliate in Argentina.

F S Appoints P. A.

George L. Miller has been named purchasing agent for **Firth Sterling Inc.** He succeeds **Harry K. Stern** who has retired after 45 years of service with the Company.

* * *

Mr. Miller joined Firth Sterling 35 years ago. Prior to this appointment, he had been assistant purchasing agent.

Wire Construction Design Manual

This new edition of **E. H. Titchener & Company's** wire component and assembly manual features case histories of how design engineers were able to cut costs and improve the quality and sales appeal of their products through the use of wire and strip metal components.

* * *

The newly revised manual de-

GREATER FLEXIBILITY IN WIRE STRAIGHTENING AND CUTTING WITH VARIABLE SPEED DRIVE

. . . in a low cost machine

- Select-O-Speed Drive permits selection of infinitely variable feed speeds from 25 to 155 FPM for all types of wire and rod.
- Available with super-sensitive electric trip mechanism.
- High-Speed Five-Die Straightener Arbor, mounted on ball bearings.
- Lewis engineered, simple, rigid, dependable . . . of best materials and workmanship.
- Ideal for manufacturers of stove and refrigerator racks, lamp shades, wire baskets, garment hangers, welding rod and other products where small diameter wire is used.

Lewis 1-C Automatic Wire Straightening and Cutting Machine. 1/16" to 1/8" capacity.

For further information write:

THE LEWIS MACHINE COMPANY

3441 EAST 76TH STREET • CLEVELAND 27, OHIO

scribes the principal types of wire available for component construction, the most popular finishes, wire sizes and the variety of end treatments, threading and forming treatments possible.

* * *

The 24-page, 8½ x 11" manual, which also describes Titchener's design and manufacturing facilities, may be obtained by writing Custom Design Department, E. H. Titchener & Co., 57 Clinton St., Binghamton, N. Y.

Rea to Have Research Laboratory

A new research laboratory to serve the electrical industry will be built in Fort Wayne for **Rea Magnet Wire Co., Inc.**, subsidiary of **Aluminum Company of America.** General plans for the project were announced by **A. C. Sheldon**, Rea vice president of operations.

* * *

The laboratory will be built on a recently acquired tract of land southeast of Fort Wayne, about 2½ miles from the company's Fort Wayne works and main office. Rea also has operations in Lafayette, Ind. The laboratory is expected to be completed in 1961.

* * *

Activities of the new laboratory will include improvement and development of insulations for copper and aluminum round magnet wire, investigation of insulations for aluminum sheet and foil strip conductor, and development of techniques and engineering data for manufacture of coils from round wire and strip conductors.

* * *

The laboratory will be directed by **E. Mark Wolf**, recently named technical director of Rea.

Ajax Electric Appoints Representative

The appointment of **Egloff & Graper, Inc.**, 1798 Industrial Way, Los Angeles 23, as sales engineering representatives in the Southern California territory has been announced by **Ajax Electric Company** of Philadelphia.

In addition to handling the complete line of Ajax electric and gas fired salt bath furnaces and related control equipment, they will likewise represent Ajax-Barkling gas-fired heat treating and melting furnaces.

* * *

Both Ed Egloff and **Bob Graper** have been active in Pacific Coast metal working circles for a number of years.

Correction

In the list of those members of **The Wire Association** to whom 25-Year certificates are awarded in 1960, through an error, **Mr. Edwin W. Krueger's** firm was given as "Krueger Steel Company" instead of **"Krueger & Co., Inc."**

* * *

This appeared on the pages in the September and October issues of WIRE AND WIRE PRODUCTS in which the 1960 list of persons had attained to a 25-Year membership status in the Association. Our apologies to Mr. Krueger.

AMERICAN IRON AND STEEL INSTITUTE
150 EAST FORTY-SECOND STREET, NEW YORK 17, N. Y.

AIS 10

SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING CARBON, ALLOY AND STAINLESS
(NET TONS)

AUGUST - 1960
Month

Covering Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or for Resale)

STEEL PRODUCTS	Items	CURRENT MONTH 1960 CARBON	ALLOY	STAINLESS	TOTAL	Percent of Total Shipments	Prior Year (1959) Percent of Total Shipments	YEAR TO DATE * 1960 CARBON	ALLOY	STAINLESS	TOTAL	Percent of Total Shipments	Prior Year (1959) Percent of Total Shipments
Ingots and Steel Castings	1A	10,393	9,577	1,373	21,343	0.4		158,288	79,973	17,024	255,285	0.5	
Blooms, slabs, billets, sheet bars	1B	67,623	22,959	1,237	91,819	1.8		788,932	283,490	13,217	1,085,639	2.1	
Tube rounds	1C	793	341	12	1,146	-		9,276	3,493	23	12,792	-	
Skelp	2	4,365	-	-	4,365	0.1		88,915	1	-	88,916	0.1	
Wire rods	3	62,834	1,308	813	64,955	1.3		640,458	20,340	7,277	668,065	1.3	
TOTAL SEMI-FINISHED	.....	146,008	34,185	3,435	183,628	3.6		1,685,859	387,297	37,541	2,110,697	4.0	
Bars--Hot Rolled (Inc. Light Shapes)	14	347,090	103,245	2,917	453,252	8.9	GEN	3,981,895	1,109,014	28,999	5,119,908	9.7	GEN
Bars--Reinforcing	15	222,708	-	-	222,708	4.4		1,443,600	-	-	1,443,600	2.8	
Bars--Cold finished	16	67,823	18,827	3,959	90,609	1.8	TO	837,730	178,277	37,129	1,053,136	2.0	TO
Tool Steel	17	613	5,103	-	5,716	0.1		7,730	55,919	-	63,649	0.1	
TOTAL BARS AND TOOL STEEL	.....	638,234	127,175	6,876	772,285	15.2	DUE	6,270,955	1,343,210	66,128	7,680,293	14.6	DUE
Standard pipe	18	162,378	131	-	162,509	3.2		1,525,755	1,074	-	1,526,829	2.9	
Oil country goods	19	61,922	16,017	-	77,939	1.5		680,175	190,033	-	870,208	1.7	
Line pipe	20	246,514	4	-	246,518	4.9		2,032,836	277	-	2,033,113	3.9	
Mechanical tubing	21	32,834	15,331	539	48,704	1.0		407,820	160,010	3,507	571,337	1.1	
Pressure tubing	22	16,834	4,738	1,399	22,971	0.4		143,169	32,735	11,074	186,978	0.3	
TOTAL PIPE AND TUBING	.....	520,482	36,221	1,938	558,641	11.0	AVAILABLE	4,789,755	384,129	14,581	5,188,465	9.9	AVAILABLE
Wire--Drawn	23	191,781	2,746	1,674	196,201	3.9		1,672,096	29,886	17,200	1,719,182	3.3	
Wire--Nails & staples	24	29,482	-	1	29,483	0.6	NOT	232,859	-	5	232,864	0.4	NOT
Wire--Barbed & twisted	25	3,550	-	-	3,550	0.1		34,110	-	-	34,110	0.1	
Wire--Woven wire fence	26	7,341	-	-	7,341	0.1		81,145	-	-	81,145	0.1	
Wire--Bale ties & baling wire	27	6,699	-	-	6,699	0.1		54,532	-	-	54,532	0.1	
TOTAL WIRE & WIRE PRODUCTS	.....	238,853	2,746	1,675	243,274	4.8		2,074,742	29,886	17,205	2,121,833	4.0	
Sheets--Hot rolled	31	491,105	13,426	1,744	506,275	10.0		5,679,484	189,918	18,434	5,887,836	11.2	
Sheets--Cold rolled	32	981,725	2,456	10,162	994,343	19.6		10,533,693	39,653	97,284	10,670,630	20.3	
Sheets--Galvanized	33	227,485	-	-	227,485	4.5		2,268,062	356	-	2,268,418	4.3	
Sheets--All other coated	34	18,803	-	-	18,803	0.4		187,631	-	-	187,631	0.4	
Electrical sheets & strip	35	1,964	35,033	-	36,997	0.7		33,143	381,696	-	414,839	0.8	
Strip--Hot rolled	36	84,231	1,257	296	85,784	1.7		948,250	15,814	3,916	967,980	1.8	
Strip--Cold rolled	37	78,437	1,562	14,649	94,648	1.8		831,599	12,028	126,770	970,397	1.8	
TOTAL SHEETS AND STRIP	.....	1,883,750	53,734	26,851	1,964,335	38.7		20,481,862	639,465	246,404	21,367,731	40.6	
TOTAL SHIPMENTS (1960)	.....	4,735,020	292,644	44,289	5,071,953	100.0	XXX	48,968,973	3,254,439	410,571	52,633,983	100.0	XXX
TOTAL--PRIOR YEAR (1959)	.....	1,200,947	116,609	21,053	1,338,609	XXX		49,723,354	3,459,242	444,767	53,657,363	XXX	

A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.

Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,951,512, TWISTER AND TRIMMER HEAD FOR SPRING ASSEMBLY MACHINES, patented September 6, 1960 by Francis Y. Wynkoop, 1205 S. Lincoln St., Denver, Colo.

The head is adapted for use with conventional machines operable to spirally advance and position a stiff wire helical in interlacing relation with juxtaposed base coil arcs of a double row of wire and is said to automatically trim, close and finish the ends of helical lacing elements applied by the machine in reaction to completion of the lacing operation accomplished thereby.

* * *

No. 2,951,657, COILING APPARATUS, patented September 6, 1960 by Arthur S. Wallin, Chicago, Ill., assignor to Hydrometals, Inc., a corporation of Illinois.

More specifically the apparatus is for coiling heavy metal strips and the like, and includes a self-locking mandrel, with new guide devices for leading the strips, etc., into threaded engagement with the mandrel. There are eleven claims.

* * *

No. 2,952,069, METHOD OF WINDING STATORS, patented September 13, 1960 by John Young, Jr., Corona, N.Y., assignor to Sperry Rand Corporation, Long Island City, N. Y., a corporation of Delaware.

This patent is related to patent 2,835,453 issued May 20, 1958, and is adapted to the winding of stators of small electrical apparatus such as motors, generators, resolvers, synchros and the like and is said to reduce the number of winding operations.

* * *

No. 2,952,240, APPARATUS FOR EXTRUDING COATING ON A TRAVELING CORE, patented September 13, 1960 by Charles W. Abbott, Clearwater, Fla., assignor to Whitney Blake Company, New Haven, Conn., a corporation of Connecticut.

More specifically, the invention relates to a new type of wiper for wiping the extruded coatings on insulated wire conductors of non-circular cross-section, as well as to a new wiper nozzle.

* * *

No. 2,952,574, METHOD OF MAKING OIL WELL CABLE, patented September 13, 1960 by Walter T. Pierce, Worcester, Mass., assignor to United States Steel Corporation, a corporation of New Jersey.

The method of manufacturing an armored cable is disclosed and comprises insulating at least one metallic conductor wire with electrical insulation, helically applying a first layer of metallic armor wires over the insulated conductor wire, helically applying a second layer of metallic armor wires over the first layer in an opposite direction of wind to the first, heating the cable to a temperature between 140° and 190° F., and applying a tension to the cable while so heated of between 40 and 70% of its rated strength.

* * *

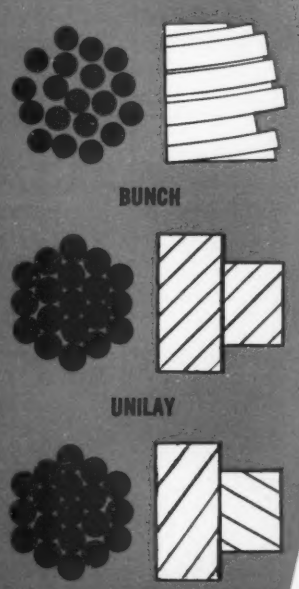
No. 2,952,728, INSULATED CONDUCTOR FOR COMMUNICATION CABLES AND THE MANUFACTURING METHOD OF THE SAME, patented September 13, 1960 by Kyohei Yokose, Higashinada-ku, Kobe, Japan, assignor to Sumitomo Electric Industries, Ltd., Konohana-ku, Osaka, Japan, a company of Japan.

A pair of electrical insulating tapes of paper are spread over the round wire conductor central portions about portions of the periphery of the conductor and their longitudinal edge portions extending beyond the periphery and secured together in face-to-face relationship so as to make the largest possible permanent triangular air gap between the joined tapes adjacent both sides of the wire conductor to reduce the electrostatic capacity of the conductor.

* * *

No. 2,953,290, WIRE CONTROL FOR

Which Wire Construction is Best . . .



Hudson makes all three in bare and plated constructions. Each is best suited for particular applications and insulating materials. For many years, the industry "standards" were bunch and concentric strandings. But with Hudson's marketing of unilay, there has been a strong swing to this versatile construction.

. . . for your Application

BUNCH constructions are generally used for flexible cords and fixture wires complying with UL standards, ASTM, and all military specs where permitted.

UNILAY constructions should be utilized where concentricity is a major requirement, or for economic reasons to get more for your insulating dollar. Since unilay constructions are preformed and twisted in the same direction. they are uniform and smaller in O.D. than bunched or concentric constructions. Unilay constructions are suited for all bunched applications, and are being substituted for concentrics in many applications with comparable performance at considerably lower conductor cost.

CONCENTRIC Where concentric strand conductors are required by customer or military spec, Hudson's concentric wires will meet the most exacting requirements.

For additional information on stranded and single-end conductors — bare and plated — write to:

HUDSON WIRE COMPANY
OSSINING DIVISION, OSSINING, NEW YORK / TELEPHONE: WILSON 1-8500

See us at Booth 29. Wire Association Convention, Chicago, Ill.

WIRE FEEDING MACHINE, patented September 20, 1960 by Michael Kostenko, Little Falls, and George W. Soderman, Alpine, N. J., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

In apparatus for repeatedly feeding a wire a known distance in a longitudinal path by reciprocation of a movable unit this distance to a position closely adjacent a fixed unit and away from the fixed unit the same distance, the wire extending through the units relative to gripping means therein operable under known pressures alternately to grip adjacent portions of the wire against movement relative to their units and alternately actuable by the wire to release the wire for movement through their units, the inventor provides a device for holding the wire against buckling in any direction during feeding thereof.

* * *

No. 2,953,309, APPARATUS FOR AND METHOD OF WINDING STATOR COILS, patented September 20, 1960 by Harry W .Moore, 5051 Kittridge Road, Dayton 24, Ohio.

There are 14 claims in this patent including method claims for winding inwardly directed poles on a stator utilizing two pairs of horns, one pair being located on one side of the stator and the other pair being located on the other side of the stator, temporary supports for one pair of horns and a wire feeding shuttle having wire feeding projections.

* * *

No. 2,953,310, APPARATUS FOR WIRE WINDING OF TANKS, TUBES OR THE LIKE, patented September 20, 1960 by William H. McLean, Quebec, Canada, and Brian R. Perry, 5699 Queen Mary Road, Montreal, Quebec, Canada; said McLean assignor to said Perry.

Apparatus for winding, stretching and tensioning a reinforcing wire around the outer circumferential surface of a cylindrical tank or the like is provided in which the frume carrying the winding devices moves around the outer surface of the tank or the like and the wire is said to be uniformily tensioned by a pair of sheaves, one of which also causes spacing of the turns of the wire.

* * *

No. 2,953,311, ARBOR FOR COIL WINDING APPARATUS, patented September 20, 1960, by Robert O. Birchler, Downers Grove, and Oliver M. Nielsen, Chicago, Ill., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

There are composed in this apparatus an arbor for removably supporting a headed spool, a member on the arbor independent of the spool and having a portion engageable with a head on the spool and an annular portion sloping from the head and cooperating therewith to form an annular groove with diverging strand-gripping surfaces for receiving and gripping a wire strand, and a device on the arbor for holding the spool and the member in engagement with each other.

No. 2,953,627, UNDERWATER ELECTRICAL CONTROL CABLE, patented September 20, 1960 by Joseph J. Malneritch, Van Nuys, and Douglas Keeney, Arcadia, Calif., assignors to Pacific Automation Products, Inc., Glendale, Calif., a corporation of California.

A relatively lightweight, compact, flexible, multi-conductor cable for underwater service is disclosed having self-sealing properties to prevent longitudinal flow of water therethrough when virtually adjacent portions of such cable are subject to ambient fluid pressure differentials of between 1000 to 3000° p.s.i.

* * *

Reissue 24,878, SOCKETED SCREW HEAD WITH UNIFORMLY OFFSET GROOVES, patented September 27, 1960 by Ian A. Smith, Willimantic, and Herman G. Muenchinger, Chaplin, Conn., assignors to American Screw Company, Willimantic, Conn., a corporation of Rhode Island.

This is a reissue of Patent 2,847,894, dated Aug. 19, 1958. The screw-head contains a cross-shaped slot of four grooves and one, which was claimed as having a "driving" side wall is now claimed as having a "first" side wall.

* * *

No. 2,953,832, WIRE TYPE ANGLE CLAMP, patented September 27, 1960 by Hillard Jay Sands, Cleveland, and Melvin E. Roche, Berea, Ohio, assignors to Harvard Manufacturing Company, Cleveland, Ohio.

A clamp for a pair of superimposed

COPPER - Consumption of refined copper in the United States, July-August 1960, in short tons

	Wire mills 1/	Brass mills 2/	Chemical plants	Secondary copper smelters	Foundries and miscellaneous	Total
July:						
Cathodes	200	3,872	(3)	46	(3)	4,118
Wire bars	38,698	2,770	(3)	---	(3)	41,468
Ingots and ingot bars	817	4,389	(3)	90	(3)	5,296
Cakes and slabs	------	7,643	(3)	---	(3)	7,643
Billets	------	10,260	(3)	---	(3)	10,260
Other	38	------	(3)	---	(3)	38
Total	39,753	28,934	(4)	136	(4)	4/70,823
August:						
Cathodes	389	8,215	(3)	52	(3)	8,656
Wire bars	70,090	3,876	(3)	---	(3)	73,966
Ingots and ingot bars	754	5,896	(3)	88	(3)	6,738
Cakes and slabs	------	12,684	(3)	---	(3)	12,684
Billets	------	13,542	(3)	---	(3)	13,542
Other	73	------	(3)	44	(3)	117
Total	71,306	44,213	(4)	184	(4)	4/117,703

1/ Includes all wire mills with rod-rolling facilities. 2/ Includes all brass mills using copper in refinery shapes; some have rod-rolling facilities. 3/ Not available. 4/ Consumption by chemical plants, foundries, and miscellaneous plants not included. Estimate of 2,000 tons included in total.

angles is claimed and is constructed in a continuous triangulate wire form.

* * *

No. 2,954,135, COIL TRANSFER MECHANISM, patented September 27, 1960 by Lorenz Iversen, Pittsburgh, Pa., assignor to Mesta Machine Company, Pittsburgh, Pa., a corporation of Pennsylvania.

There are sixteen claims to this patent for a transfer mechanism for coils of strip steel or the like and includes a rotatable lifting arm, an arbor slidably mounted transversely in the arm, a device for rotating the lifting arm between coil receiving and coil discharge positions ninety degrees apart in the same vertical plane, and means for releasing an arbor holding means when the lifting arm reaches the coil discharge position whereby the arbor is slidable through the lifting arm to provide a plane bearing face, means independent of the lifting arm positioned at a discharge point engaging the end of the arbor while released for controlled reciprocation of the arbor into and out of the lifting arm.

* * *

No. 2,954,180, COILING STRAND MATERIAL, patented September 27, 1960 by Eben Jefferson Crum, Baltimore, Md., assignor to Wirecrafters, Inc., Towson, Md., a corporation of Maryland.

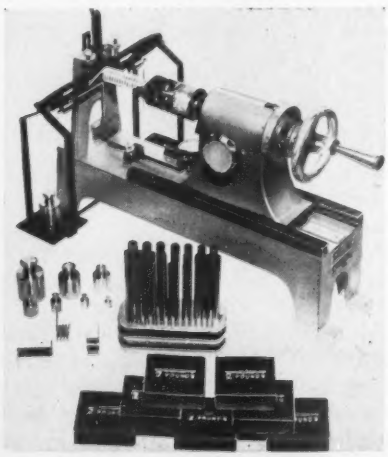
More specifically there are provided a reciprocable member having a horizontal surface for receiving the coiled material from the coiler and supporting it; and a device for effecting reciprocation of the member to cause the coils to be deposited on the horizontal surface in layers with consecutive coils of each layer in overlapped eccentric relation.

New Torsion Spring Tester

This new tester checks loads and deflections of the small, medium and average size torsion springs used in electronic devices, missile components and instruments. The tester can also be used for checking double torsion, spiral, clock and power springs.

* * *

Government and industry requirements for checking torsion springs created the need for this tester. It will be especially useful in receiving and inspection departments of spring and product manufacturers, government arsenals, aircraft plants and laboratories.



* * *

The tester can check springs having: wire diameters from 0.005 to 0.1875 in., outside diameters from 1/16 to 6 in., lengths from ⅛ to 8 in., with torque from ½ in. oz. to 80 in. lbs. and the large easily read protractor dial shows each degree of deflection. 300 to 600 tests per hour can be made.

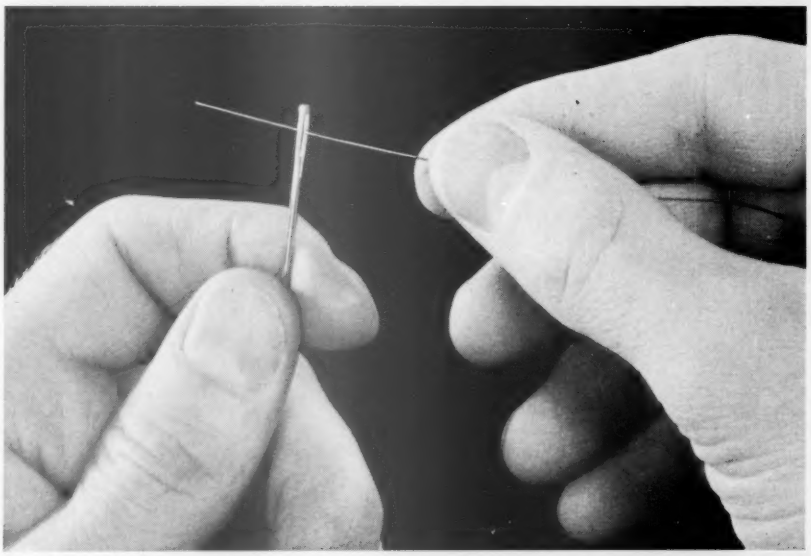
* * *

The unit comes complete with 29 arbors from 1/16 to ½ in., by 64ths, a block of small fractional ounce weights, seven 10 in. lb. weights and operating instructions. Write for free descriptive bulletin. Testers are in stock for immediate delivery.

* * *

Write H. Carlson, **The Carlson Co.**, 3457 Weidner Ave., Oceanside, L. I., N. Y.

ALLOY WIRE:
Tailor-made for Specific Purposes



Precision Drawn **Strand Annealed** Wire

THESE BASIC ADVANTAGES ARE BIG ONES:—

- Closer in tolerances than most commercial wires
- Make important savings in finished products possible
- Tailor-made with special characteristics to meet specific needs

Drawing specialty wire to consistent fine tolerances with specific characteristics of tensile, elasticity, hardness, grain size, etc., demands *exacting control* through all production phases. When applied to specific requirements, these "Specials" also require extensive know-how and advanced production facilities.

As a leading producer of finest quality paper mill wire cloth, woven mesh and cold drawn wire, our production team of metallurgists, engineers and technicians can help you select the right wires for any application and deliver them "on schedule."

WISCONSIN WIRE WORKS
APPLETON · WISCONSIN

New Catalog on Printing Machines and Marking Wheels

The Duncan M. Gillies Co., Inc., 66 Central St., West Boyleston, Mass., has issued a new and complete catalog of their products, which includes their printing machines and marking wheels for electric wire and cable, tubing, etc. Many helpful suggestions on how to achieve better printing are included.

* * *

Copies of the catalog and samples of electric wire showing the kind of printing that can be done are available upon request to the company.

Webb Wire To Build New Plant

Plans for construction of a modern wire drawing mill have been announced by **Webb Wire Division** of **The Carpenter Steel Company,** New Brunswick, N. J.

* * *

John H. Corson, division manager, said the new plant will be located on a 6-acre tract in North Brunswick Township, about three miles west of Webb Wire's present location in downtown New Brunswick. Work is scheduled to begin October 1. Completion is expected in February 1961.

* * *

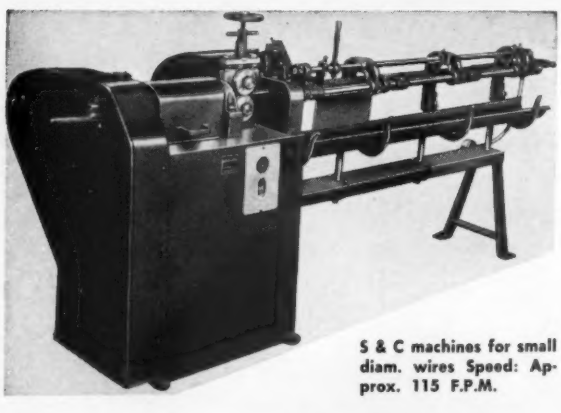
Webb Wire manufactures precision stainless steel spring wire for the mechanical spring industry, needle wire for the textile industry and surgical uses, and nickel alloy electrical wire.

* * *

The new plant will mark the end of an era and the start of a new one for Webb Wire. The company, organized by the Webb brothers in 1904, was purchased by The Carpenter Steel Company in 1951. It has occupied the Liberty Street plant in downtown New Brunswick for 56 years.

New! Improved! Fast!

WELLS STRAIGHTENER & CUTTER



S & C machines for small diam. wires Speed: Approx. 115 F.P.M.

This completely redesigned line combines maximum efficiency with that rugged dependability, for which WELLS S&C machines have become justly famous.

Built in several sizes to handle 2 to 18 ga. basic and high carbon wire.

FEATURES

The guide bar of these new machines can be supplied for any cut lengths • The rotary flier runs on ball bearings for smoothness and long life • Cut-off is actuated by a solenoid for extreme accuracy of cut lengths • A two point cam construction provides a quick and positive return of the cut-off knife, eliminating the need for a clutch and dog • A counter is standard equipment.

A COMPLETE RANGE OF S & C MACHINES IS MADE BY WELLS FOR ALL SIZES OF WIRE. SEND FOR CATALOG ON THE COMPLETE LINE.

Frank L. Wells Company

Builders of Fine Wire Working Machinery

5821 FIFTH AVENUE • KENOSHA, WISCONSIN

Gold Plated Conductors Available from Hudson Wire

Single end and stranded gold plated conductors are now available from **Hudson Wire Company's Ossining Division** on a pilot plant basis.

* * *

The extreme emphasis on reliability in the electronics industry today has caused increased concern over anticipated shelf life of components and materials. Over a period of time most conductors develop either a surface oxide or tarnish which renders the material less solderable. Gold plating can be used to eliminate this problem.

* * *

For additional information on specific conductors, contact Hudson Wire Company, Ossining Division, Ossining, N. Y.

Catalog of Swaging Machines

The Fenn Manufacturing Company of Newington, Conn., manufacturers of metal forming machinery and accessories have published a new Swaging Catalog containing their full line of machines, feeding accessories, and other related equipment. In addition to complete information on capacities and dimensions of each of the nine basic swaging machines

in the Fenn line, the catalog contains much information on applications and advantages of swaging, long die swaging, quality tests for swaging machines, hydroforming, die designs, care and operation, and installation. For copies, write to **John H. Charpentier,** The Fenn Manufacturing Company, Fenn Road, Newington, Conn., and request Catalog SM-60.

New Line of Tote Boxes

A new line of Toteline fabricated tote boxes in a virtually unlimited range of sizes and shapes has been developed by **Molded Fiber Glass Tray Co.**

* * *

The new, custom-made boxes are ideally adapted to small volume users. Samples pictured here show such typical custom-made features as hand-holes, wooden runners with rivet washers, and vent holes. Thickness of fiber glass walls ranges from 1/16 inch to 3/16 inch.

* * *

Fabricated tote boxes are available in a combination of fiber glass reinforced plastic panels (also vulcanized fiber panels or sheet aluminum panels) riveted to a top frame, top and bottom caps and reinforcing angle made of galvanized steel. Write Molded Fiber Glass Tray Co., Linesville, Pa.

U.S. Rubber Plans New Plant in England

Witco Chemical Co., Inc., and the **United States Rubber Co.** have announced plans for a new chemical company, **Sto-Chem Ltd.,** to manufacture synthetic rubber latex in England. Each corporation will own 50 per cent of the new company. **George R. Vila,** Vice President of U. S. Rubber, will serve as Chairman of the Board.

* * *

When the Sto-Chem plant, to be built on a 20-acre site in the Midlands of England, goes into operation in the fall of 1961, it will have an initial annual capacity of 8,000,000 pounds. The total investment will be more than $2,500,000.

* * *

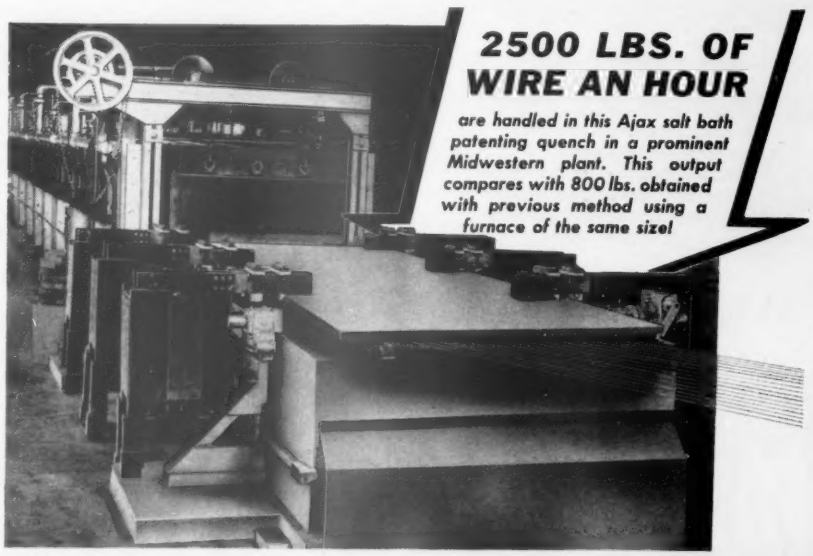
The Sto-Chem plant is planned to meet a rapidly rising demand for various forms of latex in the United Kingdom. A complete line of butadiene-styrene, high styrene, nitrile and acrylic types of synthetic rubber latex will be manufactured in the new plant.

Hudson Establishes Warehouse On Coast

A West Coast warehouse for bare conductors has been announced by the Ossining Division of **Hudson Wire Company,** Ossining, N. Y. The new warehouse will make possible immediate delivery of items now sold in the area. These items, including stranded and single end silver plated and tinned copper, are fully tested and inspected to meet ASTM and MIL specifications. Certification will be furnished upon request.

* * *

Hudson's new facility will be handled by their sales representative **Perlmuth Electronic Associates,** with offices in Los Angeles, San Diego, and Palo Alto, California.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are handled in this Ajax salt bath patenting quench in a prominent Midwestern plant. This output compares with 800 lbs. obtained with previous method using a furnace of the same size!

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Effects of Environmental and Other Conditions on Dissipation Factor and Dielectric Constant Of Very Low-Loss Polyethylene Compounds

(*Continued from page* 1532)

ethylene specimens for longer periods (up to 30 and 45 days) was performed. Data are shown in Tables IX, X, and XI. Samples (46), (47), (49), and (55) were immersed in sea water instead of distilled water.

* * *

Electrical tests were made at 1MC only, except in the cases of Samples (51) and (52), which were tested at 100KC also, before and after 14 days in distilled water.

* * *

From the data in Tables IX and XI, it is indicated that no unusual effects were obtained for sea water-immersed specimens, as compared with specimens immersed in distilled water.

* * *

All of the samples in Tables IX and XI, and Samples (53) and (54) in Table X, showed virtually no change in electrical properties after water-immersion, in contrast to the results reported for the samples of Table VIII.

TABLE XII

EFFECT OF SOAKING IN BENZENE ON ELECTRICAL PROPERTIES OF POLYETHYLENE

DISSIPATION FACTOR (D) AND DIELECTRIC CONSTANT (K) AT 1MC, 24°C, TESTS PERFORMED CONSECUTIVELY IN ORDER GIVEN

	(a) Original		(b) In Benzene 16 Hrs.		(c) Vacuum Treated 16 Hrs.		Dried Naturally For 24 Hrs.	
Sample No.	D	K	D	K	D	K	D	K
(57)	.000072	2.2700	.000045	2.2647	.000067	2.2694	-	-
(58)	.000134	2.2711	.000056	2.2636	-	-	.000091	2.2694
(59)	.000125	2.2703	.000057	2.2657	.000091	2.2708	-	-
(60)	.000123	2.2722	.000056	2.2648	-	-	-	-
(61)	.000122	2.2729	.000060	2.2656	-	-	-	-
(62)	.000096	2.2735	.000055	2.2678	-	-	-	-

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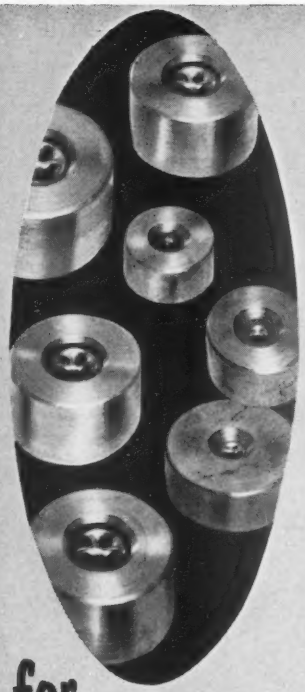

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VI. Effect of Soaking Polyethylene Electrical Test Specimens in Benzene

Electrical tests on polyethylene specimens by the "benzene cell" method are often repeated numerous times on the same day. This raises the question as to whether or not the benzene may affect the electrical properties. To investigate this point several 50-mil plaques of representative polyethylene materials were soaked in benzene overnight (about 16 hours) at room temperature. Electrical measurements were performed on these specimens, both before and after benzene-immersion. Results are given in Table XII. They show that in every instance there were marked decreases in both the dissipation factor and dielectric constant. The change in dielectric constant can probably be explained by the decrease in average density of the polyethylene test specimens due to swelling by benzene. No wholly satisfactory explanation for the large decreases in the dissipation factor is yet apparent.

Conclusion

The devotion of a considerable portion of this paper to a discussion of recently improved electrical measuring techniques seems justified because it is only through these improvements that the investigations of the effects of various environmental and other conditions on the electrical properties of polyethylene have become possible. The data obtained thus far on the effects of various conditions have partially answered some questions, but each experiment has raised many additional ones. Much more work needs to be done in many areas, and it is anticipated that these and other investigations on this important subject will be pursued further.

* * *

The author acknowledges the valued assistance of **Mr. H. F. Tomfohrde** in connection with much of the work reported.

REFERENCES

(1) **Tentative Method of Test for Dielectric Constant and Dissipation**

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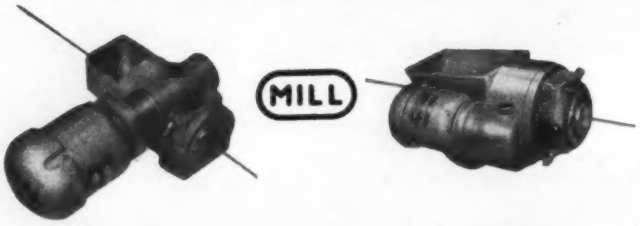

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Sherwatt Appoints Distributor

Samuel K. Hornor, sales manager of **The Sherwatt Equipment and Manufacturing Company, Inc.**, has announced the appointment of **The MacInnes Steel Sales Company** as sales representatives for Sherwatt's products in New York State and Northwestern Pennsylvania.

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Alfred MacInnes, President of The MacInnes Steel Sales Co., has headquarters located at 201 Marine Bank Bldg., Erie, Pa., with a branch office at 317 State Tower Bldg., Syracuse, N. Y.

New Parallel Shaft Speed Reducer Book

"Parallel Shaft Speed Reducers" is a new 36-page book (2719) that describes Link-Belt's completely redesigned and expanded line of "balanced design" parallel shaft reducers in 57 sizes, including 23 new sizes. Single, double and triple reduction units are available in capacities up to 2,800 h.p. at high or low output speeds, and ratios up to 292:1.

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* * *

A copy of Book 2719 is available free by writing to **Link-Belt Company**, Dept. PR, Prudential Plaza, Chicago 1, Ill.

Literature on Cobalt Alloys

A data sheet on new cobalt-base and nickel-base superalloys is available from the **Cobalt Information Center.** This four-page compilation lists physical and mechanical properties, corrosion resistance, thermal treatment, fabrication, available forms, and applications of 13 alloys, including Nivco 10, J-1570, J-1610, WI-52, Nicrotung, Inco 717C, and Unitemp 1753.

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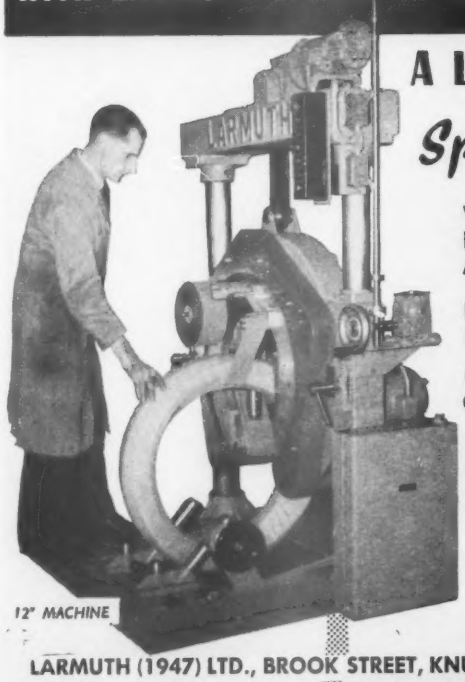

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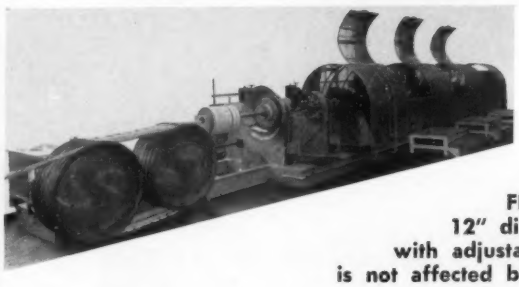

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Another recent publication of the Center is "Thermal Shock and Thermal Fatigue of Cobalt Alloys and Cermets." This 65-page compilation of references from 1938 to 1960 includes a brief introduction, 84 selected, informative abstracts, 14 tables, and 13 figures.

* * *

This literature is available from Cobalt Information Center upon request. Write to the Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio; the Centre d'Information du Cobalt, 35, rue des Colonies, Brussels, Belgium, will honor requests from persons abroad.

Signal Corps Symposium Dates Set

The Ninth Annual Wire and Cable Symposium jointly sponsored by the **U. S. Army Signal Research and Development Laboratory** and industry will be held at the Berkeley-Carteret Hotel, Asbury Park, N. J., on November 30, and December 1 and 2. As in the past, some 25 papers will be presented showing the technical progress during the preceding year in the field of communication wires and cables.

* * *

Howard F. X. Kingsley, Communications Dept., U. S. Army Signal Research and Development Laboratory, is general chairman. The co-chairman is **Fred W. Wills,** also of the laboratory.

Announces New Blast Cleaning Abrasive

A completely new blast cleaning abrasive designed to occupy a position between present malleable abrasives and steel both from the standpoint of performance and initial cost has been announced by **Pangborn Corporation,** Hagerstown, Md.

Fenn Holds Open House on 60th Anniversary

The Fenn Manufacturing Company, 1 Fenn Road, Newington, Conn., took note of its attainment to 60 years of corporate existence on September 29, 1960, by holding a special open house to provide

members of the press, suppliers, customers, families of employees, and friends an opportunity to see the company's complete manufacturing facilities and products at the Newington plant. The firm has another plant at New Britain.

* * *

Now in its third generation of Fenn management, the company operates under the able guidance of **Wilson L. Fenn,** grandson of the founder, **Wilson Lee Fenn.**

* * *

In 1948 the company bought the **Standard Machinery Company** of Providence, R. I., which marked Fenn's entry into the wire field through the acquisition of manufacturing rights to a line of rolling mills, wire flattening machines, swaging machines, Turks Heads and automatic presses. Many improvements in these have been made in the intervening years.

* * *

The company also has achieved considerable note as designers and makers of special machinery, as producers of rotor heads, gear boxes and tail rotor assemblies for helicopters, of nuclear reactor parts, superchargers for aircraft, textile machinery, printing presses, missile parts and numerous other diversified products, all of precision construction.

* * *

Under a reciprocal agreement with Marshall-Richards of England, Fenn machines now are made in Great Britain and Marshall-Richards' wire drawing equipment will be made in this country for sale here, Canada and Mexico.

* * *

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* * *

The manufacturer labels the new abrasive — called Pangborn G — "a significant development, the product of a long research program" and further describes it as "a material as close to steel as possible to make in a cupola."

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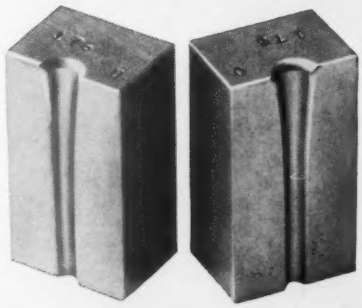

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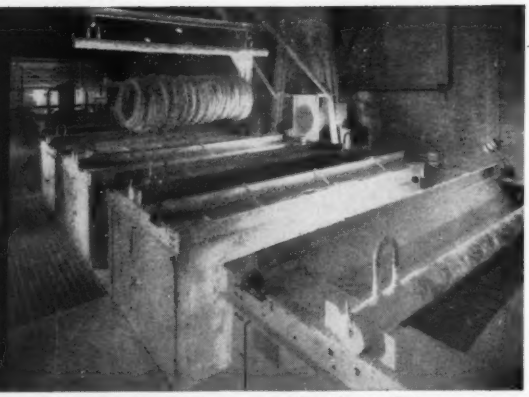

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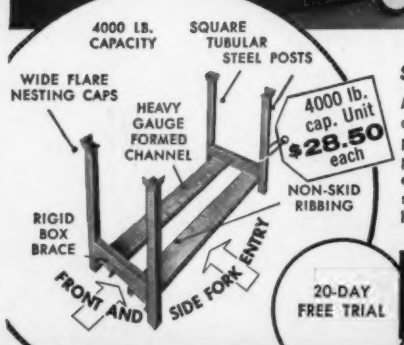

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* * *

Pangborn believes there is a definite application and requirement for this new abrasive in the middle priced range and, when used under proper conditions, will offer new possibilities for reducing overall abrasive costs.

A S & W Cable Controls Undersea Vehicle

A five-mile length of silver-plated electrical cable soon will enable Naval oceanographers for the first time to conduct scientific studies of ocean depths for prolonged periods.

* * *

The cable, specially designed and produced at the Worcester (Mass.) **Electrical Cable Works** of U. S. Steel's **American Steel and Wire Division** and silver-plated for greater conductivity, is the heart line of an awesome-looking remote-controlled underwater device with the body of a Marine Corps "Ontos" tank, an electro-mechanical arm which synthesizes the motions of its human counterpart, and four "eyes" in the form of television cameras which can transmit to a monitor screen on shore a three-dimensional picture equal in clarity to a good home movie.

* * *

Uses for the manless undersea vehicle — called "RUM" (remote underwater manipulator) — include observations of the sea floor, the collection of samples and specimens from the depths, and the assembly and installation of deep-bottom mounted instrumentation in the ocean. It has recently undergone tests off the California coast.

* * *

RUM can operate at depths down to 20,000 feet, and can crawl along the ocean floor at about 3 miles an hour. It can maneuver and operate on a 60 per cent grade, and is capable of climbing vertical objects 12 inches in height. It soon may be equipped with an "underwater helicopter" with rotor blades, which

will permit it to raise or lower itself in the water, move sideways, hover like a helicopter, or just "float."

Wickwire Rope Used on Sacramento Channel Dredging

The Colorado Fuel and Iron Corporation is supplying its Wickwire rope for the dredges which are being used in the Sacramento River Deep Water Channel project, a project which will create a seaport of California's capital, Sacramento.

* * *

Scheduled for completion in 1962, the 43-mile long, 30 foot deep channel, will link Sacramento with the Pacific Ocean and will allow ocean-going ships to travel 90 miles inland to Lake Washington. The estimated cost of the project is $43 million.

* * *

Swing lines, anchored on the shores, are worked off drums aboard the dredges. The dredges swing their heads from side to side by pulling on one swing line and releasing the other. As the dredges reach the forward limit of the the swing lines, the anchors on shore are moved forward to allow the entire operation to be repeated.

* * *

Basically, the dredges are floating platforms. Extending from the bow of each dredge is the cutter head and suction head, supported by a ladder or boom. The ladder, weighing between 90 and 100 tons uses Wickwire rope to hold the tremendous weight of the heads as they work along the channel bed.

Reynolds Expands Washington Plant

A $600,000 expansion of **Reynolds Metals Company's** aluminum reduction plant at Longview, Wash., to make possible production of extrusion ingot, other improved ingot products and bar stock for making aluminum conductor wire was announced today by **D. W. Johnson,** plant manager.

* * *

The expansion, scheduled for completion in six months, will include additional floor area of about 13,000 square feet. The building addition will house three new holding furnaces for processing of the metal prior to casting ingot of various shapes and sizes. New equipment also will include a horizontal casting machine, sawing equipment and homogenizing furnaces.

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Replacement Chart Catalog

A new 14-page catalog of replacement strip chart papers has been published by the **Judson Bigelow Sales Div., Techni-Rite Electronics, Inc.,** P. O. Box 3575-F, Providence 10, R. I. A complete listing of replacement charts for all makes and models of recorders is included, with cross references to recorder manufacturers' model numbers. Judson Bigelow sales representatives and warehouses are also listed.

SKF Bearing Damage Detector

An SKF Industries' Bearing Damage Detector — believed the first using a unique electronic system — was shown to a military symposium as a device for highly accurate inspection without need to disassemble bearings.

* * *

Elimination of the need to take used bearings apart through use of the Detector to adequately assure no surface damage is estimated to result in savings of several million dollars a year to bearing users.

* * *

For further particulars, write SKF Industries, Inc., Front St. & Erie Ave., Philadelphia 32, Pa.

Industrial Ovens Designed for Air Pollution Control

This article discusses basic design methods for applying all-metal catalyst elements for air pollution control in a wide range of industrial ovens, furnaces and dryers. Tells how hazardous combustible exhause fumes are converted to clean, safe, re-useable heat energy, by economical catalytic oxidation. For a copy, write Catalytic Combustion Corp., 4725 14th St., Detroit 8, Mich.

The Challenge of Spent Acid

(*Continued from page* 1543)

salts used for sludge preparation. Also, spent acid can act as a coagulant for sewage and make existing primary plants more effective, thus postponing construction of more treatment facilities. Spent acid is also being used at water treatment plants.

* * *

Spent acid hauled to a sewage treatment plant does not harm sewers or streams. Holding facilities at the treatment plant permit a controlled rate of discharge to the sewage flow as a flocculant or to the sewage sludge as a conditioner prior to filtering. The result provides a means of disposal of a waste problem and a means of reducing costs for the municipality. The full flow from a city will neuralize large volumes of acid. Dilution of the iron concentration to acceptable limits will determine the volume of acid the city plant can handle.

Recommendations

Industries that consider a waste discharge in terms of its effect on the river can properly evaluate control methods and interim procedures. Such evaluation can not only define the reasonableness of regulations but also anticipate their effectiveness in promoting the public welfare. But such evaluations necessitate stream survey work and in-plant surveys that show sources, volumes and strengths of waste, operating controls, and possibilities for minimizing acid consumption consistent with product quality control.

* * *

A full evaluation will permit assessing benefits derived from various degrees of treatment against the cost involved. This emphasizes the need to recognize all the uses of a stream, including waste disposal, in terms of their roles in the development of public welfare. It would be better for the public welfare to have money spent on increased production facilities than for an unnecessary degree of treatment.

* * *

. . **Such** an evaluation can also suggest a stepwise program that can be instituted to reduce, if not eliminate, the polluting effects of a discharge on a river.

* * *

Such a program will minimize the expense of waste control and prevent unnecessary expense. It also will provide basis for justification of the waste control program and understanding of the role of the company in community welfare development. Such understanding will assure continued operation of facilities rather than promote arguments to justify bypassing or inadequate controls.

* * *

Construction and operation of treatment facilities cost money. But the cost of the treatment plant is no criterion of its effectiveness. Since treatment of wastes is a step in process operation, it deserves management and operating attention to insure maximum efficiency and effectiveness at minimum cost.

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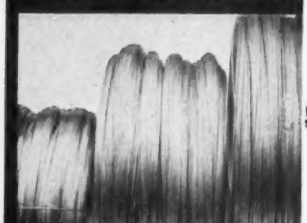
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The incentive for providing accomplishment of objectives is the elimination of the need for more governmental regulation.

Wire Kinks

(*Continued from page* 1559)

This is nothing more than ground up corn cobs and is something that is sold by most plating supply houses and can be bought in various grades of fineness. It is usually used dry, but can be used wet in which case it does a faster polishing job. However, using it wet introduces complications such as having to provide for drainage, drying, etc.

* * *

Corn meal is an even better polishing agent, but is more expensive and is only used where highly exacting finishes are required.

The Cleaning of Carbon Steel Wire as Affected by the Metallurgical Nature of the Scale

(*Continued from page* 1554)

and have shown that the improved cleaning conditions on patented rod over green rod are actually brought about by scale breakage over the tension rolls and not necessarily by the patenting operation itself. A comparison of cleaning times indicates that a green rod, reeled under controlled accelerated cooling conditions, can possess a complete coverage of the periphery by a reduced thickness of mill scale and still clean faster than a patented and reeled rod having almost identical scale weight.

Acknowledgments

The writer wishes to acknowledge the valued assistance provided by **F. L. Jamieson, L. Eaton, F. Kurth** and **V. R. Jefferess** of the metallographic staff of the metallurgical and chemical laboratories of The Steel Company of Canada, Limited, Hamilton Works, who prepared the photomicrographs and photographic studies used in this paper. The writer also wishes to acknowledge the contributions of **E. G. Baker**, chief wire metallurgist, and his staff at Canada Works and Parkdale Works in gathering data on the full scale pickling and descaling tests so necessary to this report.

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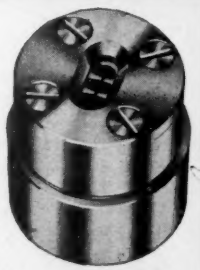

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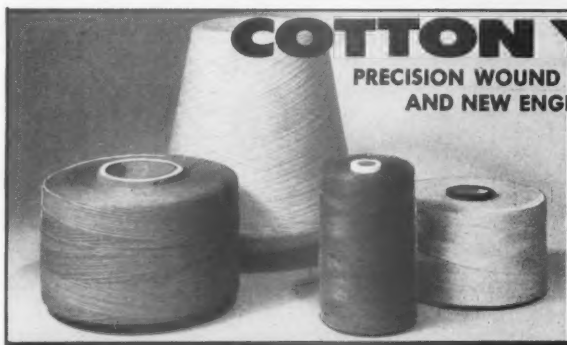

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The Mark Carbide Company, manufacturer of tungsten and chrome carbide wire drawing round, shaped and sectional dies and tube mandrels, has announced the removal of its plant and offices from Warren, Mich., to new and larger quarters at 23881 Dequindre, Hazel Park, Mich. The company now has a new telephone number: LIncoln 5-0606.

Folder on Fencing

A 4 page folder deals with types and styles of Stan Gard chain link fence and gates recommended for home, industry, institution, and recreation area use. Detail drawings show framework, fence and gate fittings, and typical erected fence section with all components required for a finished installation. Complete specifications on seven selected styles, gate specifications, and information on how to order are also included in this guide.

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Symposium on High-Voltage Cable Insulation

The necessity of transmitting ever increasing amounts of electric power to satisfy demand has forced utilities to use higher and higher voltages in power cables; some in excess of 300 kv. In turn cable manufacturers are faced with the problem of producing cables safe and reliable enough to handle these high voltages.

* * *

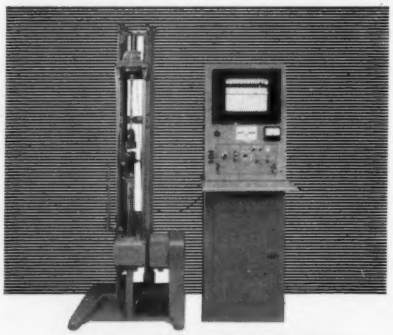
This symposium on high voltage cable insulation brings to bear on the problem the views of experts in this field. Particular emphasis is placed on the requirements for materials, for their proper application, and on test methods that will reveal the capabilities and faults of insulation systems used for extra high voltage transmission. Requirements are becoming more stringent, although oil impregnated paper still provides the most satisfactory insulation.

* * *

The symposium was jointly sponsored by AIEE Subcommittee on Insulated Conductors and ASTM Committee D-27 on Electrical Insulating Liquids and Gases. The volume is extensively referenced and is the eighth of a series on insulating oils.

* * *

Copies of the symposium papers may be secured from the **American Society for Testing Materials,** 1916 Race St., Philadelphia 3, Pa., for $1.50, which are contained in a 39-page book with heavy paper covers.



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Technical Data Sheets on Geon

The B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland 15, Ohio, has issued technical data sheets on four types of its Geon Plastics — 8730, 8800, 8803 and 8875. These give complete information on the properties, colors and applications. These Data Sheets are available from the company upon request.

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Moisture Control in Plastics Preceding Extrusion for Wire and Cable

(*Continued from page* 1546)

tiles and oil. Similar to the atmospheric pressure type, the hopper is mounted above the extruder and the material is introduced at the top from some type of a conveyor. In this design, a vacuum valve is closed and a vacuum pump started by a pellet level indicator whenever the hopper is filled.

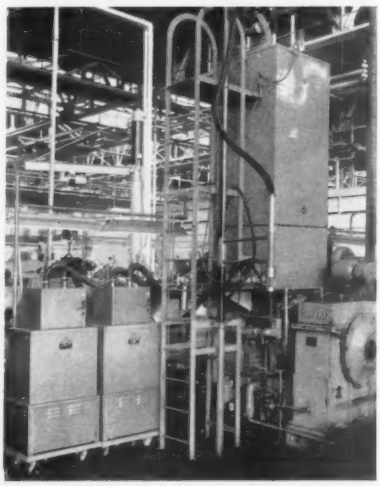

Fig. 4 — Polyethylene hopper dryer installation.

When the level drops to a predetermined value, the vacuum pump is stopped and the valve again opens. Like the first type, no extra handling labor is needed for loading and there is no moisture picked up by the material after it leaves the dryer.

* * *

Devolatilizing Extruders—These extruders are used to remove moisture from the extrudate during the extrusion process.

* * *

In summarizing, some extrusion defects have been given which are associated with excessive moisture adsorption in the material. The reasons for moisture adsorption in plastics have been discussed. The nitrogen sweep method of moisture analysis was described. The need for establishing a tolerable moisture limit was outlined. The factors which influence drying rates have been given. Methods of moisture control have been discussed with reference to the shipment of material in large lots such as hopper cars and the shipment of smaller lots of material in bags and disposable containers.

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Setting Incentive Rates in a Steel Wire Mill Under a Union Contract

(*Continued from page* 1520)

before and after. Is the method in use a good one? Is the job safe? Thirdly, is the crew assignment satisfactory?

* * *

Before a new layout of equipment has been approved for installation, the Industrial Engineering Department has an opportunity to review the layout drawings of the Plant Engineering Department. The flow of the material, the storage areas, and the employee working areas are all considered. Then, of course, when the equipment is installed and the employees are working on the job further improvements are usually made. While the method is being considered from the point of view of its efficiency, so is the job considered from the safety viewpoint. In respect to the crew assignment, usually this is considered before the equipment is installed or even designed. In order to do this, of course, reasonably accurate time values are necessary; the amount of work involved in the job must be known. In most cases, the work time is developed from known work times of similar jobs or if necessary, estimations of work element times are made. Then, of course, after the job is working the percentage of work is calculated using the time study data to again decide if this is the most desirable crew assignment.

* * *

Now that we have seen how the new incentive concepts at the Roebling Wire Mills have developed and how they are applied, let us for a minute or two discuss how this plan is functioning. Presently there are in the Wire Mills Division 40 "new type" incentive plans and 25 "old type" plans covering about 450 employees. The actual earnings of these "new type" plans vary up to a maximum of 148 percent of the Standard Hourly Wage Rate with exception of one plan which earns 170 percent of the Standard Hourly Wage Rate. The average of the Wire Mills Division is 130 percent of the Standard Hourly Wage Rate.

* * *

These incentive plans are kept up-to-date. Production supervision notifies us of all changes as they occur, or in the case of major changes which in most all cases require large expenditures, we are notified of the possible change when the request for the appropriation is originally made. Immediately when changes do occur we investigate the effect of the change on the rate taking whatever time studies are necessary. If the change changes the rate less than 2½%, we merely review the effect of the change with employees and the Union and no change is made in the rate. This information is filed for further consideration. When another change is made then the effect of all changes is considered.

* * *

One more factor that indicates our incentive practices are proving satisfactory I would like to bring out is reflected in small number of incentive rate grievances we presently have in process. Years back we had a large number of incentive grievances in process at all times

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and quite a few of these would end up in Arbitration. Today we rarely have more than one or two active incentive rate grievances at any one time and they are usually settled by the time they reach the 3rd step grievance meeting, the meeting before Arbitration.

Planning and Scheduling in the Wire Mill

(*Continued from page* 1536)

are controlled separately by clerks working in close cooperation with the Scheduling Supervisor. In each of the departments a constant review of order backlogs is maintained, and when necessary, the Sales Department requested to supply additional tonnages to maintain profitable operating levels.

* * *

The Shipping Department accumulates orders from the Shipping Preparation Departments and will ship less than a truckload, truckload or carloads as directed by the Sales Orders, and prepares all necessary bills and reports. The Scheduling Supervisors and the Backlog Clerks check the shipping reports against the orders as originally received to determine whether the orders as shipped are correct, complete and on time, and then compile performance and tonnage reports — and maybe, once in a while, a delinquency report.

* * *

Schedules are not inviolate. Inflexibility results in decreasing customer satisfaction. Schedules are altered, adjusted and revised constantly: this must be so. Capacity must always be found for that bonafide "emergency" order, for the justified replacement order, for the experimental trial coil. And then there are always the adjustments caused by unexpected breakdowns of equipment and the alternate procedures required to by-pass inoperative machines. All these, and more, must be absorbed into the mill's schedules — and yet, there must be a minimum of delay to the customer.

* * *

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be. True, there have been sometimes moments of desk-thumping ultimatums, but the frequency has diminished almost to non-occurrence. We sought to improve deliveries, eliminate delinquencies and satisfy customer demands, and we have succeeded, and the success was achieved by following thru on this briefly sketched program of self-enlightenment and cooperation.

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* * *

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* * *

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* * *

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Employment of Mature Workers

National Association of Manufacturers, 2 East 48th St., New York 17, N. Y., in its Industry Report for September, 1960, devotes the issue to "Employment of Mature Workers"; that is, those of 45 or more years of age.

* * *

The results of investigations into this question, the plus and minus qualifications of older men, the costs involved, the role of government, and the progress to date, etc., are embodied in this bulletin summarizing the results of inquiries made of 70 leading companies. Copies are available upon request to NAM.

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Hyprez Div., Engis Equipment Co., Chicago, Ill.
Pangborn Corporation, Hagerstown, Md.
Wheelabrator Corporation, Mishawaka, Ind.

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(See Inhibitors, Pickling)

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Syncro Machine Co., Perth Amboy, N. J.

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(See OVENS—Rod Bakers)

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Apco Mossberg Co., Attleboro, Mass.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

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U. S. Borax, New York, N. Y.

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Colbourne Machine Company, Winsted, Conn.
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Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

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Amchem Products, Inc., Ambler, Pa.

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Apex Alkali Products Co., Phila., Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Parkin Chemical Co., The, Pittsburgh, Pa.
Standard Industrial Compounds Co., Frankfort, Ill.

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Wickwire Bros., Cortland, N. Y.
Wisconsin Wire Works, Appleton, Wis.

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Blane Corporation, The, Canton, Mass.

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Hyprez Div., Engis Equipment Co., Chicago, Ill.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

COMPOUNDS—Extrusion, for Wire
Amchem Products, Inc., Ambler, Pa.
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Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.

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COMPOUNDS—Rust Removing
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Union Carbide Plastics Company, Div. of Union Carbide Corporation, New York, N. Y.

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(See DRUMS—Wire Packaging)

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Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

CORDS—Electrical, Tinsel Conductor
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COUNTERS—
(See MACHINERY—Measuring Wire and Cable)

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Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio
Morgan Construction Co., Worcester, Mass.
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Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France

DIES—Diamond
Ajax Industrial Supplies, Inc., Ft. Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J. Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Ft. Wayne Wire Die Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

DIES DIAMOND—Reversible
Alabama Wire Die Co., Fayette, Ala.
Indiana Wire Die Co., Fort Wayne, Ind.
National Wire Die Co., Inc., New York, N. Y.

DIES—Extrusion
Central Tool and Machine Co., Bridgeport, Conn.
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France.
Rusch Wire Die Corp., Croton-on-Hudson, N.Y.
Wayne Wire Die Co., Linden, N. J.

DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.

DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Pittsburgh Carbide Die Co., Monongahela, Pa.

DIES—Pointing
Sjogren Tool & Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Alabama Wire Die Co., Fayette, Ala.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

DIES—Roll Threading
Rivom, Dijon, France

DIES—Special Shapes, Etc.
Alabama Wire Die Co., Fayette, Ala.
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Rivom, Dijon, France

DIES—Swaging
Sjogren Tool & Mach. Co., Inc., Auburn, Mass.

DIES—Tinning
Roux Wire Die Works, Inc., Oriskany, N. Y.

DIES—Tube Drawing
Alabama Wire Die Co., Fayette, Ala.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRIVES—Variable Speed
Allis Co., Louis, Milwaukee, Wisc.

DRUMS—Wire Packaging
Hubbard Spool Company, Div., Van Norman Industries, Inc., Garrett, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

DRUMS & TRAVERSES—For Cable Reels
Hubbard Spool Company, Div., Van Norman Industries, Inc., Garrett, Ind.
Republic Steel Corp., Berger Div., Canton, Ohio

DRYING EQUIPMENT—
Carl Mayer Corp., The, Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

DUST COLLECTORS—Wet or Dry
Pangborn Corporation, Hagerstown, Md.
Wheelabrator Corporation, Mishawaka, Ind.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FOAM PRODUCING COMPOUNDS—
Amchem Products, Inc., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FURNACES—Brazing
Ajax Electric Company, Philadelphia, Pa.

FURNACES—Galvanizing Equipment
Ofenbau Fritz, G.m.b.H. & Co., K. G., Hagen, (W. Germany)
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Ofenbau Fritz, G.m.b.H. & Co., K. G., Hagen, (W. Germany)
Wilson Lee Engr. Co., Cleveland, Ohio

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Company, Philadelphia, Pa.
Ofenbau Fritz, G.m.b.H. & Co., K. G., Hagen, (W. Germany)

FURNACES—Salt Bath
Ajax Electric Company, Philadelphia, Pa.

FURNACES—Strand Annealing
Ajax Electric Company, Philadelphia, Pa.
Ofenbau Fritz, G.m.b.H. & Co., K. G., Hagen, (W. Germany)

GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool & Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS—
Blane Corporation, The, Canton, Mass.
Dow Corning Corporation, Midland, Mich.
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, Naugatuck, Conn.

LACQUERNG SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Standard Industrial Compounds Co., Frankfort, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINE CONTROLS—Electronic
Allis Co., Louis, Milwaukee, Wisc.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Behr Machinery & Equipment Co., Rockford, Ill.
Glader Wm., Machine Works, Chicago, Ill.

MACHINERY—Blast Cleaning
Pangborn Corporation, Hagerstown, Md.
Wheelabrator Corporation, Mishawaka, Ind.

MACHINERY—Bobbin Winders
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

MACHINERY—Bolt, Rivet, Screw, etc.
National Machinery Co., Tiffin, Ohio
Prutton Corporation, Cleveland, Ohio.
Straus-Artys Corp., Great Neck, N. Y.

MACHINERY—Braiding
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Fall, R. I.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Bunching
Cook Mfg. Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
Miyazaki Iron Works, Ltd., Osaka, Japan
New England Butt Co., Division of Wanskuck Co., Providence R. I.
Niehaus K. A. Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Vaughn Mach'y Co., Cuyahoga Falls, Ohio

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corp., New York, N. Y.

MACHINERY—Chain Link Fence
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Chain Making
Larmuth and Bulmer, Ltd., Manchester, Eng.
Steel & Wire Machinery Co., Cleveland, Ohio
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Closing Cable
Larmuth and Bulmer, Ltd., Manchester, Eng.
Miyazaki Iron Works, Ltd., Osaka, Japan
Niehaus, K. A. Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Coulter & MacKenzie Machine Co., Bridgeport, Conn.
Vaughn Mach'y Co., Cuyahoga Falls, Ohio

MACHINERY—Cold Heading
Behr Machinery & Equipment Co., Rockford, Ill.
National Machinery Co., Tiffin, Ohio
Straus-Artys Corp., Great Neck, N. Y.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn Machinery Corporation, Hackensack, N. J.
Johnson Machinery Co., Elizabeth, N. J.
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden
National Mach'y Exch., (Used), New York
Showa Machine Works, Ltd., Osaka, Japan
Steel & Wire Machinery Co., Cleveland, Ohio
Straus-Artys Corp., Great Neck, N. Y.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Watkins & Sons, Inc., R. S., Sandy Hook, Conn.
Whitacre Corporation, Alhambra, California

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Loma Machine Manufacturing Co., Inc., New York, N. Y.
Mettler Machine Tool, Inc., New Haven, Conn.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Cutters, Hydraulic for Rod & Bar
Manco Mfg. Co., Bradley, Ill.

MACHINERY—Dead Block (Stationary Coiler)
Morgan Construction Co., Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Corporation, Alhambra, California
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Descaling Rod, Dry
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Fisher Associates, New York, N. Y.
Herborn Machinery Corporation, Hackensack, N. J.
Pangborn Corporation, Hagerstown, Md.
Wheelabrator Corporation, Mishawaka, Ind.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Diameter Control
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.
National Standard Electronics, Inc., New York, N. Y.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Sjogren Tool & Machine Co., Auburn, Mass.
Wayne Wire Die Co., Linden, N. J.

MACHINERY—Draw Benches
American Laubscher Corp., New York, N. Y.
Loma Machine Manufacturing Co., Inc., New York, N. Y.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Eccentricity Control (Insulated Wire)
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.
National Standard Electronics, Inc., New York, N. Y.

MACHINERY—Edging (See MACHINERY—Tandem Rolling and Edging Mills)

MACHINERY—Enameling
Acrometal Products, Inc., Minneapolis, Minn.
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler Co., C. A., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research and Development Corporation, Mystic, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Johnson Machinery Co., Elizabeth, N. J.
Royle, John, & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Flat Wire
Fenn Manufacturing Co., Newington, Conn.
Herborn Machinery Corporation, Hackensack, N. J.
Mettler Machine Tool, Inc., New Haven, Conn.
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.
Watkins & Sons, Inc., R. S., Sandy Hook, Conn.

MACHINERY—Forming Wire
National Mach'y Exch., (Used), New York, N. Y.
Nilson Machine Co., A. H., Shelton, Conn.
Steel & Wire Machinery Co., Cleveland, Ohio
Straus-Artys Corp., Great Neck, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Footage Meters
National Standard Electronics Inc., New York, N. Y.

MACHINERY—Galvanizing Wire
Miyazaki Iron Works, Ltd., Osaka, Japan
Ofenbau Fritz G.m.b.H. & Co., K. G., Hagen, (W.-Germany)
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Whitacre Corporation, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Impregnation Control, Paper Cables
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research and Development Corporation, Mystic, Conn.
Litzler Co., C. A., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Insulation Testing (See MACHINERY—Spark Testing)

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia, Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler Co., C. A., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Looms, Wire Weaving
EVG., Machinen & Stahl, A. G., Zurich, Switzerland

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Diam., Insulated Wire
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.
National Standard Electronics, Inc., New York, N. Y.

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wisc.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Ltd., Manchester, Eng.
National Standard Electronics, Inc., New York, N. Y.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Measuring and Control—Coating
Davis-Standard, Div. of Franklin Research and Development Corp., Mystic, Conn.
National Standard Electronics, Inc., New York, N. Y.

MACHINERY—Measuring Width-Flat Wire
National Standard Electronics, Inc., New York, N. Y.

MACHINERY—Nail and Tack
Behr Machinery & Equipment Co., Rockford, Ill.
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Co., Tiffin, Ohio
National Mach'y Exch. (Used), N.Y., N.Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Packaging Wire
Advanced Wyrepak Co., Bridgeport, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Corporation, Alhambra, California

MACHINERY—Patenting Wire
Ofenbau Fritz G.m.b.H. & Co., K. G., Hagen, (W.-Germany)
Whitacre Corporation, Alhambra, California

MACHINERY—Pin Making
Nilson Machine Co., A. H., Shelton, Conn.

MACHINERY—Plating
Bartell Machine Tool Corp., Rome, N. Y.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Herborn Machinery Corporation, Hackensack, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch., (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Straus-Artys Corp., Great Neck, N. Y.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Mach'y Co., Cuyahoga Falls, Ohio

MACHINERY—Printing on Electric Wire
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

MACHINERY—Re-Spooling
Acrometal Products, Inc., Minneapolis, Minn.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Herborn Machinery Corporation, Hackensack, N. J.
Miyazaki Iron Works, Ltd., Osaka, Japan
National Mach'y Exch. (Used), New York, N. Y.
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc., (used), Pawtucket, R. I.

MACHINERY—Rod Mill
Baldwin-Lima-Hamilton, Industrial Division, New York, N. Y.
Herborn Machinery Corporation, Hackensack, N. J.
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Fenn Manufacturing Co., Newington, Conn.
Loma Machine Manufacturing Co., Inc., New York, N. Y.
Morgan Construction Co., Worcester, Mass.
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.
Watkins & Sons, Inc., R. S., Sandy Hook, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research and Development Corporation, Mystic, Conn.
Litzler Co., C. A., Cleveland, Ohio.
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc., (used), Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Slitting Mills
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.
Steel Equipment Company, Cleveland, Ohio

MACHINERY—Special
Stanat Mfg. Co., inc., Westbury, L. I., N. Y.
Watkins & Sons, Inc., R. S., Sandy Hook, Conn.

MACHINERY—Spring Making
Behr Machinery & Equipment Co., Rockford, Ill.
National Mach'y Exch., (Used), New York, N. Y.
Torrington Mfg. Co., Torrington, Conn.
Wafios Machinery Corp., Hackensack, N. J.
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Straightening & Cutting
American Laubscher Corp., New York, N. Y.
Behr Machinery & Equipment Co., Rockford, Ill.
Johnson Machinery Co., Elizabeth, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Loma Machine Manufacturing Co., Inc., New York, N. Y.
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N.Y.
Patterson, George C., Machine Co., Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Wafios Machinery Corp., Hackensack, N. J.
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Stranding
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Phila., Pa.
Johnson Machinery Co., Elizabeth, N. J.
Krupp, Fried., Maschienn-Und Stahlbau Rheinhausen, Germany
Larmuth & Bulmer Ltd., Manchester, Eng.
Miyazaki Iron Works, Ltd., Osaka, Japan
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Fenn Manufacturing Co., Newington, Conn.

MACHINERY—Tandem Rolling & Edging Mills
Fenn Manufacturing Co., Newington, Conn.
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.

MACHINERY—Take-Up and Pay-Out
Acrometal Products, Inc., Minneapolis, Minn.
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research and Development Corporation, Mystic, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Johnson Machinery Co., Elizabeth, N. J.
Larmuth & Bulmer Limited, Manchester, England
Litzler Co., C. A., Cleveland, Ohio.

Miyazaki Iron Works, Ltd., Osaka, Japan
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Pourtier Pere et Fils, Romainville (Seine) France
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Corporation, Alhambra, California

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Pourtier Pere et Fils, Romainville (Seine) France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Thread Rolling
Behr Machinery & Equipment Co., Rockford, Ill.
Mettler Machine Tool, Inc., New Haven, Conn.
Prutton Corporation, Cleveland, Ohio.
Straus-Artys Corp., Great Neck, N. Y.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Tinning Wire
American Insuating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler Co., C. A., Cleveland, Ohio
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Corporation, Alhambra, California

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Tube Mill, Cold Drawing
Johnson Machinery Co., Elizabeth, N. J.
Loma Machine Manufacturing Co., Inc., New York, N. Y.
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N.J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
Johnson Machinery Co., Elizabeth, N. J.
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Variable Speed Drives
Allis Co., Louis, Milwaukee, Wisc.

MACHINERY—Welded Wire Mesh
EVG, Maschinen and Stahl, A.G., Zurich, Switzerland
Schlatter, Ltd., H. A. Zollikon/Zurich
Sommer Products Company, Peoria, Ill.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery—Welding Wire Fabrics)

MACHINERY—Winding Wire
Davis Electric Co., Wallingford, Conn.
Davis-Standard Div. of Franklin Research and Development Corp., Mystic, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Larmuth and Bulmer, Limited, Manchester, England
Miyazaki Iron Works, Ltd., Osaka, Japan
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Straus-Artys Corp., Great Neck, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Laubscher Corporation, New York, N. Y.
Behr Machinery & Equipment Co., Rockford, Ill.
Cook Manufacturing Co., The, Paterson, N.J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Fenn Manufacturing Co., Newington, Conn.
Herborn Machinery Corporation, Hackensack, N. J.
Johnson Machinery Co., Elizabeth, N. J.
Loma Machine Manufacturing Co., Inc., New York, N. Y.
Miyazaki Iron Works, Ltd., Osaka, Japan
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Showa Machine Works Ltd., Osaka, Japan
Societa Generale Delle Macchine Mill, Milan, Italy
Stanat Mfg. Co., Inc., Westbury, L. I., N. Y.
Steel Wire and Machinery Co., Cleveland, Ohio
Straus-Artys Corp., Great Neck, N. Y.
Superior Tool & Machinery Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Watkins & Sons, Inc., R. S., Sandy Hook, Conn.
Whitacre Corporation, Alhambra, California
Wire Machinery Inc., Chicago, Ill.

MACHINERY—Wire Preheating
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.

MACHINERY—Wire Rope
Larmuth and Bulmer, Ltd., Manchester, Eng.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
American Laubscher Corp, New York, N. Y.
Larmuth (1947) Ltd., Cheshire, England

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio

MOTORS—Electric
Allis Co., Louis, Milwaukee, Wisc.

NAIL TOOLING—Tungsten Carbide
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Central Tool and Mach. Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Co., Winsted, Conn.
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio

PAILS—Packaging
(See Drums—Wire Packaging)

PAPER—Coil Wrapping
Ludlow Papers, Needham Heights, Mass.

PAPER—Insulating
Ludlow Papers, Needham Heights, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
Twitchell, Inc., E. W., Philadelphia, Pa.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PLASTICIZERS—
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

PLASTICS—for Wire Insulation
Blane Corporation, The, Canton, Mass.
Dow Corning Corporation, Midland, Mich.
Escambia Cnemical Corp., New York, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Union Carbide Plastics Company, Div. of Union Carbide Corporation, New York, N. Y.
Union Carbide Corporation, Silicones Division, New York, N. Y.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck, Chemical Division, Naugatuck, Conn.

PRINTING WHEELS—for Electric Wire
Daniels & Co., Frank, New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

PULLERS AND GRIPS—for Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool & Mach. Co., Auburn, Mass.
Vaughn Mach'y Co., Cuyahoga Falls, Ohio

RACKS—Wire Storage
Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—
Acrometal Products, Inc., Minneapolis, Minn.
Mettler Machine Tool, Inc., New Haven, Conn.
Northern Indiana Steel Supply Co., Michigan City, Ind.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Berger Div., Canton, Ohio

REELS—Metal Bound
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.

REELS—Plywood
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Clark Manufacturing Co., J. L., Rockford, Illinois
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Northern Indiana Steel Supply Co., Michigan City, Ind.
Republic Steel Corp., Berger Div., Canton, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Nelson Co., The, Baltimore, Md.
Northern Indiana Steel Supply Co., Michigan City, Ind.
Republic Steel Corp., Berger Div., Canton, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Wood Working Co., Montello, Wisc.
Bridge Mfg. Co., The, Hazardville, Conn.
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.
Nelson Co., The, Baltimore, Md.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Marathon Specialty Steels, Inc., N. Y., N. Y.

RODS—Wire—Non-Ferrous
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Detroit Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

ROPE—Wire
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons, Div., Colorado Fuel & Iron Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—RUST Removing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—
Watson Machine Co., Paterson, N. J.

Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

SILICONE RUBBER—For Wire Insulation
Dow Corning Corporation, Midland, Mich.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—For Retail Sale of Wire
American Wood Working Co., Montello, Wisc.
Clark Manufacturing Co., J. L., Rockford, Illinois

SPOOLS—Plastic
Hubbard Spool Company Div., Van Norman Industries, Inc., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Plastic Mold & Eng. Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

STOCK STORAGE SYSTEMS—
Jarke Manufacturing Co., Chicago, Illinois

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.

TANKS—Ceramic, for Galvanizing
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TENSION METERS—for Wire
Boulin Instrument Corp., Pelham, N. Y.
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.
Tensitron, Inc., Harvard, Mass.

TESTERS—INSULATION
(See Testing Equipment—for Dielectric Faults)

TESTING EQUIPMENT—Dielectric Faults in Insulation
Davis Electric Co., Wallingford, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Muirhead Instruments, Inc., (Addison Electric), New York, N. Y.
Peschel Electronics, Inc., Patterson, N. Y.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

TESTING EQUIPMENT—Physical
Scott Testers, Inc., Providence, R. I.

TINSEL—Electric Conductor
A. C. S. Industrial Div., American Copper Sponge Co., Inc., Woonsocket, R. I.
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.
(See TINSEL-Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

TRANSMISSIONS—Variable Speed (See Adjustable Speed Drives)

TRAVERSE & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Insulating Materials Section, Schenectady, N. Y.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
EVG, Maschinen and Stahl, A.G., Zurich, Switzerland
Herborn Machinery Corporation, Hackensack, N. J.
Micro Products Co., Chicago, Ill.
Schlatter, Ltd., H. A., Zollikon-Zurich

WHEELS—for Printing on Electric Wire
Daniels & Co., Frank, New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

WIRE—Aluminum
Hudson Wire Co., Ossining, N. Y.
Malin & Co., The, Cleveland, Ohio

WIRE—Ball
Marathon Specialty Steels, Inc., N. Y., N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brake Lining
Hudson Wire Co., Ossining, N. Y.

WIRE—Brass and Bronze
Malin & Co., The, Cleveland, Ohio
Wisconsin Wire Works, Appleton, Wis.

WIRE—Brush
Hudson Wire Co., Ossining, N. Y.

WIRE—Bunched and Stranded
Camden Wire Co., Camden, N. Y.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Copper
Camden Wire Co., Camden, N. Y.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., The, Cleveland, Ohio

WIRE—For Electrical Conductors
Camden Wire Co., Camden, N. Y.

WIRE—Flat
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
A. C. S. Industrial Division American Copper Sponge Co., Inc., Woonsocket, R. I.
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Montgomery Co., The, Windsor Locks, Conn.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Detroit Steel Corporation, Detroit, Mich.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., N. Y., N. Y.
Republic Steel Corp., Berger Div., Canton, Ohio
Roebling's, John A., Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div. The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Metalizing
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Malin & Co., The, Cleveland, Ohio

WIRE—Needle
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wisconsin Wire Works, Appleton, Wis.

WIRE—Nickel Silver and Phosphor Bronze
Malin & Co., The, Cleveland, Ohio
Wisconsin Wire Works, Appleton, Wis.

WIRE—Oil Tempered
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
Roebling's, John A., Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Wisconsin Wire Works, Appleton, Wis.

WIRE—Stainless Steel
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Malin & Co., The, Cleveland, Ohio
Marathon Specialty Steels, Inc., New York, N. Y.
Nippon Stainless Steel Wire Mfg. Co., Ltd., Osaka, Japan.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wisconsin Wire Works, Appleton, Wis.

WIRE—Steel—Also Coppered and Galvanized Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Denver, Oakland & New York City.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Wisconsin Wire Works, Appleton, Wis.

WIRE—Stranded & Bunched
Hudson Wire Co., Ossining, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide Rolls, Bushings, Wear Parts, etc.
American Wood Working Co., Montello, Wisc.

WRAPPING PAPER—Creped
(See PAPER-Creped Wrapping)

YARN TESTERS—
National Standard Electronics, Inc., New York, N. Y.
Scott Testers, Inc., Providence, R. I.

YARNS—Wire Insulating
Chadwick Yarn Company, Pawtucket, R. I.
Synthetic Thread Co., Bethlehem, Pa.

The WATSON MACHINE COMPANY

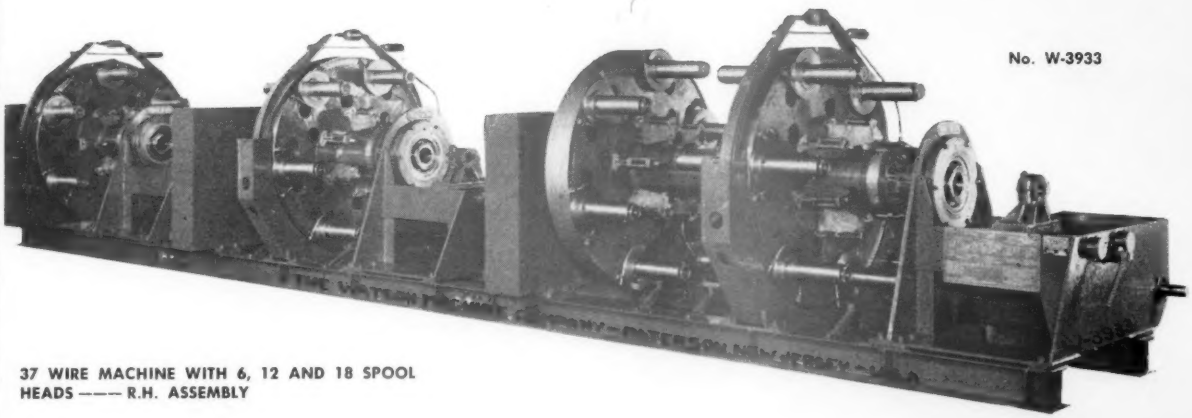
ESTABLISHED 1845

PATERSON 16, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE
AND MASTICATING MACHINERY MANUFACTURERS

WATSON

RIGID FRAME STRANDING HEADS



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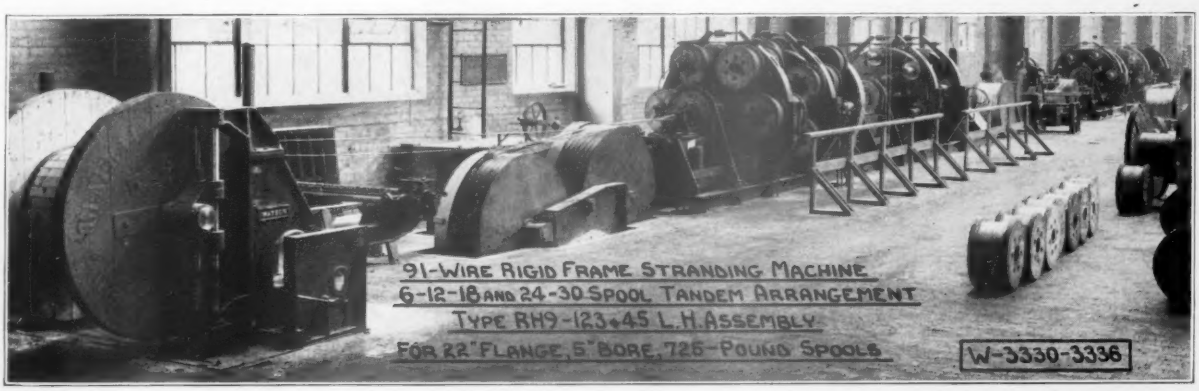
37 WIRE MACHINE WITH 6, 12 AND 18 SPOOL HEADS ——— R.H. ASSEMBLY

REFERRED TO AS THE "WORKHORSE" IN MANY CABLE PLANTS, OUR RIGID FRAME STRANDERS "RH" NOW PERFORM MANY TASKS PREVIOUSLY RESERVED FOR THE MORE EXPENSIVE AND SLOWER PLANETARY STRANDERS. THEY ARE EXCELLENT PRODUCERS OF ACSR, CONCENTRIC COPPER STRANDS OF ALL SHAPES AND FORMS AND CAN ALSO STRAND SOFT ARMOR WIRE AND MANY TYPES OF INSULATED CONTROL AND COMMUNICATION CABLES. CONSTRUCTION IS HEAVY, ALL STEEL AND BALL BEARING. AUTOMATIC BRAKES ARE FAILURE-PROOF. LATCH SAFEGUARDS. SPEEDS ARE HIGH AND LOADING IS QUICK. MAINTENANCE IS LIMITED TO PERIODIC LUBRICATION AND OIL GAUGE CHECK. ALL SIZES.

MANY AUXILIARIES AVAILABLE.

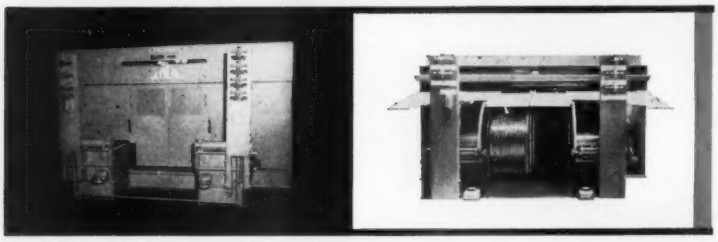
INSPECTIONS ARRANGED FOR.


91-WIRE RIGID FRAME STRANDING MACHINE
6-12-18 AND 24-30 SPOOL TANDEM ARRANGEMENT
TYPE RH9-123+45 L.H. ASSEMBLY
FOR 22" FLANGE, 5" BORE, 725-POUND SPOOLS
W-3330-3336

NON-STOP SPOOLING with CONTINUREEL

Where wire production calls for high speed non-stop spooling, call on Syncro CONTINU-REEL®, a fully automated bare wire spooler that will introduce new profits by eliminating costly shutdowns.

CONTINUREEL is recommended for speeds up to 5000 fpm for EC aluminum (slightly less for copper), accommodating two large capacity spools separately mounted. The unit is piped and fitted with all necessary air control devices and can be adapted to most conventional wire drawing operations.



For a detailed description and specification sheet on the Continureel spooler, direct request to Syncro Machine Company, Dept. C, Perth Amboy, New Jersey, or 'Phone HIllcrest 2-5500.

Affiliated Company: Winget-Syncro Ltd., Rochester, Kent, England.

SYNCRO®

WIRE DRAWING MACHINES – STRANDERS – CONTINUOUS ELECTRIC ANNEALERS – PAYOFFS – CAPSTANS – WIRE INSULATORS – HEAVY DUTY TAKEUPS – TAPERS – SPECIAL MACHINERY